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AGENESIS OF THE CORPUS CALLOSUM

ITS DIAGNOSIS BY ENCEPHALOGRAPHY*

REPORT OF THREE CASES

By LEO M. DAVIDOFF, M.D., *and* CORNELIUS G. DYKE, M.D.
NEW YORK CITY

THE diagnosis of agenesis of the corpus callosum has hitherto depended upon its accidental disclosure at necropsy, since a specific clinical syndrome has never been established. The anomaly probably occurs more frequently than would appear from the number of cases reported in the literature. This view is substantiated by the fact that at the Neurological Institute of New York during a period of three years, 3 cases of agenesis of the corpus callosum were observed and recognized by encephalography. During this period 1,100 encephalograms were made.

Since the first published case by Reil in 1812, a total of 83 cases of partial or complete agenesis of the corpus callosum were found at necropsy and were reported in the literature. In none of the patients was the diagnosis made during life. The present report is based on 3 cases, in all of which encephalograms were made. One of these cases was verified at necropsy and the other two were diagnosed during life by means of characteristic encephalographic findings. A search of the literature on agenesis of the corpus callosum since the introduction of encephalography by Dandy in 1919 reveals only one case in which encephalography was performed. The agenesis of the corpus callosum in this case, recorded by Guttmann, was encountered accidentally at the post-mortem examination. His description of the encephalograms in full is as follows:

> The encephalogram of the case showed, aside from a deformity and slit-like narrowing of both anterior horns, a hydrocephalus of the posterior horns, especially on the left; further a marked enlargement of the third and fourth ventricles and the cisterna cerebello-medullaris, as well as an exaggeration of the surface markings of the brain convexity.

It is obvious that this author failed to recognize the characteristic changes in the encephalograms of his patient, or diagnose the condition during life.

The clinical and encephalographic data in the 3 cases forming the subject of the present report follow.

CASE 1.† (N. I. No. 16591.) N.E., private patient of Dr. Frederick Tilney, a white female child, aged six, was admitted to the Neurological Institute of New York for the third time, October 23, 1933.

† An extended study of this case with special reference to the cortical fields is in progress by Drs. Frederick Tilney and Samuel T. Orton, to whom the writers are indebted for the privilege of using this case in the present paper.

* From the Departments of Neurosurgery and Roentgenology, Neurological Institute of New York. Read before the American Association of Neuropathology, New York, Dec. 28, 1933.

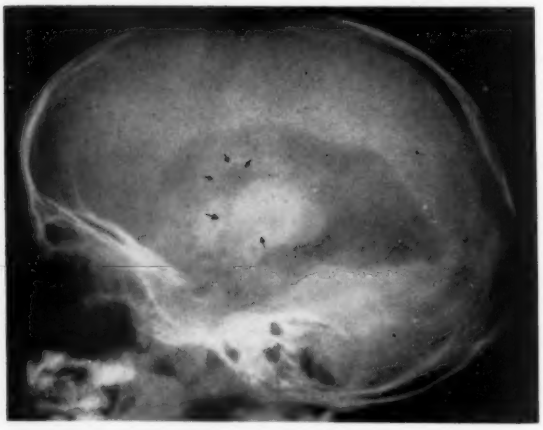

Fig. 1. Case 1. Showing enlargement of the lateral ventricles, especially the posterior parts of the bodies. Arrows indicate the boundary of the third ventricle. Note its abnormal dorsal extent.

Complaint. Convulsive seizures of the left side of face and entire body.

Present Illness. The child first became ill at the age of two years (December, 1928) with a sudden onset of vomiting, unconsciousness and high fever. This illness lasted two weeks. She recovered fully from this episode and remained well until April 11, 1929, at which time she again had a sudden attack consisting of vomiting, cyanosis and unconsciousness during which convulsive movements of the left side of the body and face occurred which lasted about twelve hours. On examination at this time she showed a left hemiparesis. After recovery from the acute symptoms she remained with a permanent weakness on the left side. From this time on she continued to have repeated seizures, Jacksonian in character, on the left side.

Encephalography. On December 11, 1930, encephalograms were made (No. 18971). These showed the bodies of the lateral ventricles to be moderately and symmetrically enlarged. The enlargement was especially marked in the posterior portion of the bodies (Fig. 1). The dorsal margins of the lateral ventricles were somewhat pointed. The lateral ventricles were separated a distance of 3.8 cm. from each other and the medial borders of the ventricles had a concavity mesially. The ventricular system was displaced slightly to the right. The right anterior horn was not visualized.

The third ventricle was considerably enlarged and extended upward much beyond its usual dorsal limit. This was particularly true of the rostral portion of this ventricle (Fig. 2). The aqueduct and fourth ventricle were not visible. The cisternae pontis and interpeduncularis were well filled and apparently normal in size, shape and position. The cisterna laminae cinereae terminalis was straight instead of being concave cephalically. The cerebral sulci on the medial aspect of the hemisphere were arranged in a dorsoventral direction and the cingulate and callosal sulci were not visible.

Subsequent History. Following the air insufflation the child showed remarkable improvement for about two years, in that her seizures were reduced both in frequency and severity. After this period of time the seizures became more frequent and she was readmitted to the hospital. At this time she was six years old and had a left hemiparesis with a definite hypoplasia of the left side of the body. A number of indications of premature puberty were noted, including a scanty growth of pubic and axillary hair and development of the breast on the normal (right) side. The child was cooperative and intelligent and showed a high average intelligence quotient (1.07) on the Merrill-Palmer scale.

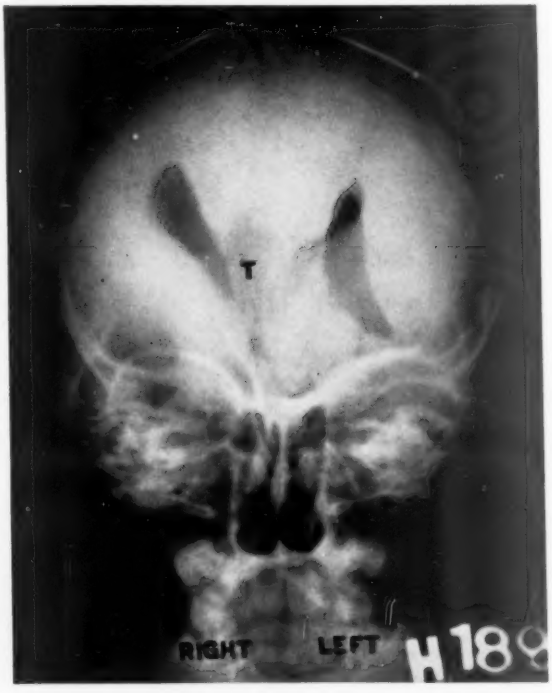

Fig. 2. Case 1. Showing the wide separation of the lateral ventricles, their pointed dorsal margins and concave mesial aspects. The third ventricle (T) is markedly enlarged and irregular in shape, and extends dorsally beyond the normal limits.

Operation. On October 24, 1933, a small right osteoplastic craniotomy was done exposing the superior margin of the frontal lobe. This was retracted laterally from the midline and a search made for a cyst of the cavum of the septum pellucidum. A cavity was entered from which a discharge of a large quantity of clear, colorless fluid occurred. The child failed to survive the operation and a post-mortem examination was made.

Post-Mortem Examination. The necropsy was limited to the head. The brain showed marked asymmetry, the right hemisphere being considerably smaller than the left. The frontal pole of the smaller hemisphere showed a complete absence of convolutional development, due to a pathological condition unrelated to the anomaly of the corpus callosum. This will be described in detail by Drs. Tilney and Orton. The posterior pole of the left hemisphere was characterized by microgyria. On sagittal section the brain showed complete absence of the corpus callosum. The septum pellucidum was also absent and the third ventricle extended dorsally beyond its normal limit. Its roof was formed by a thin arachnoid membrane. The fornix continued directly dorsally from the lamina terminalis. The interventricular foramina were elongated. The position of the corpus callosum was occupied by a number of anomalous gyri which were arranged in a ventrodorsal direction with a tendency to radiate from the roof of the third ventricle. This gave rise to an entirely abnormal convolutional pattern in which the usual major sulci and convolutions were not recognizable (Figs. 3 and 4). The lateral aspects of the brain aside from the major sulci also showed markedly anomalous patterns. This was especially true of the right half.

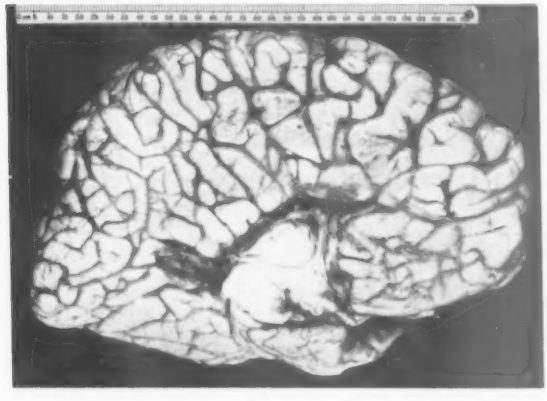

Fig. 3. Case 1. Sagittal hemisection of the brain, left hemisphere. The corpus callosum and septum pellucidum are absent, the third ventricle extends dorsally farther than usual and the posterior portion of its roof is flattened from above. The convolutions and sulci are arranged radially centering around the third ventricle.

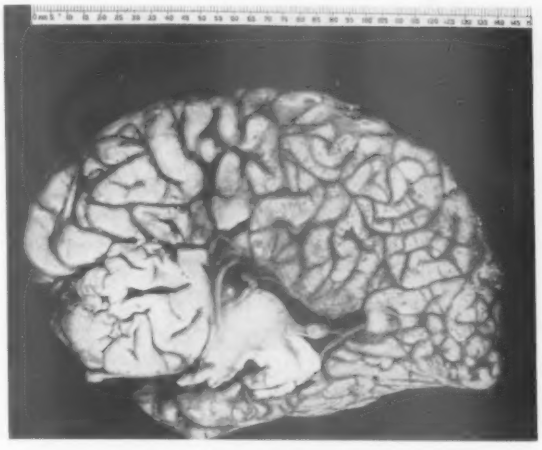

Fig. 4. Case 1. Sagittal hemisection of the brain, right hemisphere. In addition to the changes noted in Figure 3, there is hypoplasia of the frontal pole with macrogyria in this region and microgyria elsewhere. Note the difference in size of the two hemispheres.

On coronal section of the brain the encephalograms were strikingly corroborated. A section taken through the interventricular foramina showed the lateral ventricles to be markedly separated by a ventral folding of the anomalous mesial convolutions to fill the space

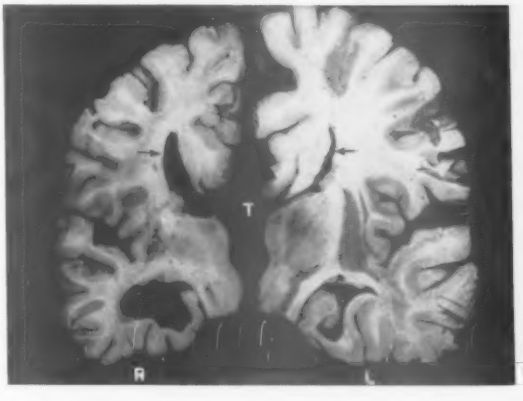

Fig. 5. Case 1. Coronal section of the brain through the interventricular foramina showing the absence of the corpus callosum, the concave mesial borders of the lateral ventricle, the dilatation of the third ventricle and its abnormal dorsal extent (cf. Fig. 2).

normally occupied by the corpus callosum. The rostral part of the body and the anterior horns of the lateral ventricles were narrowed, especially in the left hemisphere. The interventricular foramina were markedly elongated, and on the right widely dilated. The third ventricle was enlarged and extended dorsally between the bodies of the lateral ventricles. It occupied a slightly eccentric position to the right, owing to the hypoplasia of the right cerebral hemisphere (Fig. 5).

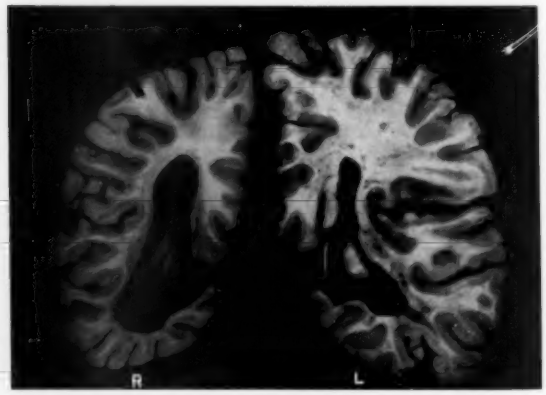

FIG. 6. Case I. Coronal section of the brain through the junction of the bodies and temporal horns of the lateral ventricles showing the dilatation of the caudal portions of the lateral ventricles, especially the right.

Another coronal section made through the junction of the bodies with the temporal horns of the lateral ventricles showed an enlargement of this portion of the ventricular system as compared with the rostral portion, the right lateral ventricle again being the larger one (Fig. 6).

Comment. The separation of the bodies of the lateral ventricles and the concavity of the mesial margins of these ventricles as seen in the encephalogram suggested the presence of a cyst of the cavum septi pellucidi and cavum Vergae. At the time the encephalograms were made the large collection of air seen between the lateral ventricles which included the space normally occupied by the third ventricle (Fig. 2) was interpreted as occupying the cavity of the septum pellucidum and cavum Vergae, the walls of which were ruptured during the procedure, permitting the egress of fluid and the ingress of air. The patient's improvement for the next two years seemed to bear out the assumption that the cyst had been ruptured during the air insufflation.

When the patient's convulsive seizures recurred she was readmitted to the hospital for the third time. Another encephalogram was performed which failed to show any air in the ventricular system. A review of the previous encephalograms raised some doubt in our minds concerning the correctness of the diagnosis of a cyst of the cavity of the septum pellucidum. It was suspected that the accumulation of air between the lateral ventricles instead of being in a cyst was the result of some anomaly of the brain involving the roof of the third ventricle; however, the possibility of the presence of a cyst of the cavum septi pellucidi and cavum Vergae was sufficiently great to warrant an exploratory craniotomy. The child succumbed after the operation and the post-mortem examination revealed a complete agenesis of the corpus callosum and the vertical arrangement of the gyri

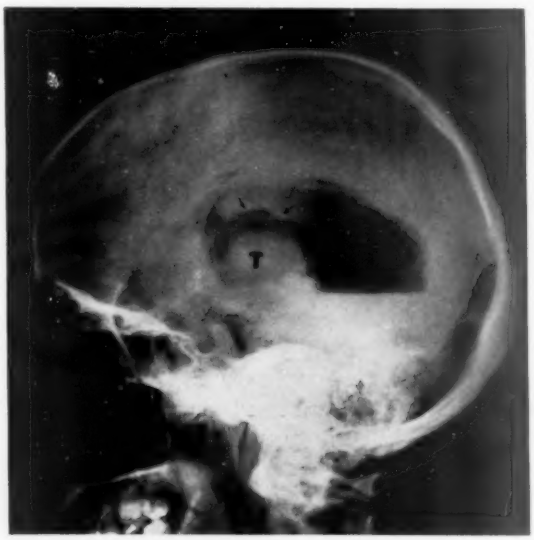

FIG. 7. Case II. The lateral ventricles are dilated, especially in their posterior portions. Cephalically they end abruptly at a point opposite the interventricular foramina. The third ventricle (T) is seen to extend well up between the shadows of the lateral ventricles. Arrows indicate the dorsal margin of the third ventricle.

and corresponding sulci on the medial aspect of the brain.

Case II. (N.I. No. 17548.) E.R., a white male, aged twenty-one, was admitted to the Neurological Institute of New York on October 10, 1933.

Complaint. Convulsions.

Present Illness. The patient was perfectly well until fourteen years of age when he began to have severe frontal headaches, each of which lasted about one hour. These occurred about once a month for a period of one year. At sixteen he began to have grand mal seizures. These were somewhat Jacksonian in character for the clonic contractions affected the left side of the face and left upper and lower extremities, more than the right. He is unconscious for five to ten minutes during an attack and the left side of his body feels weak thereafter. The attacks recur every nine days.

Past and Family History. Irrelevant.

Physical Examination. The patient was a cooperative, well-nourished male. His gait was normal. The finger to nose and finger to finger tests were poorly done on the left. All succession movements were poor on the left. The deep reflexes were slightly increased on the left. The cranial nerves were all intact except that the visual fields showed some constriction suggesting a partial left superior homonymous quadrantic defect.

Fig. 8. Case II. Showing the wide separation of the lateral ventricles, their pointed dorsal margins, and concave mesial aspects. The third ventricle (T) is markedly enlarged and extends dorsally beyond its normal limits. Note the elongated interventricular foramina (arrows).

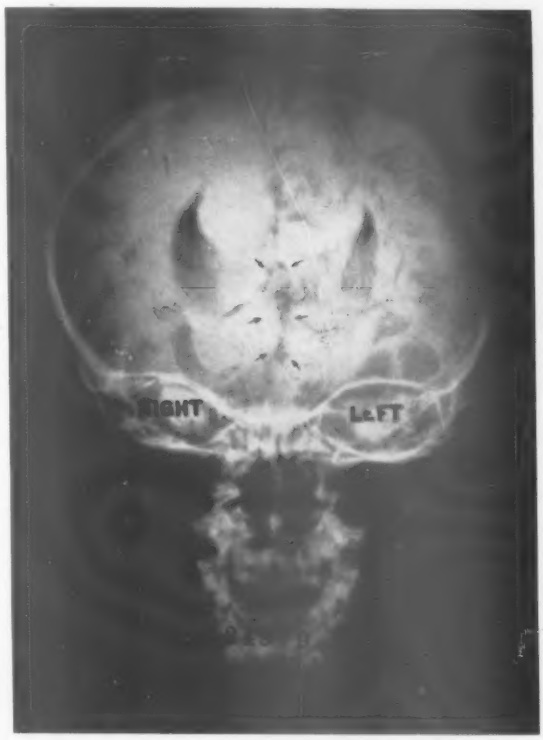

Fig. 9. Case III. The lateral ventricles are widely separated, their dorsal margins are pointed and their mesial aspects are concave. The third ventricle is moderately enlarged and extends dorsally beyond its normal limits. Arrows indicate the outline of the third ventricle.

Roentgen Examination (No. 26161). The plain skull films showed nothing abnormal. The encephalograms showed the bodies of the lateral ventricles to be moderately and symmetrically dilated, especially the posterior portions (Fig. 7). They formed a rather sharp angle dorsally and widened out ventrally. The ventricles ended abruptly cephalically at a point opposite the interventricular foramina. The lateral ventricles were separated from each other 4.3 cm. and their medial walls were concave mesially. The third ventricle was greatly enlarged and extended dorsally much higher than usual, thus appearing between the bodies of the lateral ventricles. The lateral ventricles were each joined with the third ventricle by a

linear passageway filled with air, about 3 mm. in width and 1.5 cm. in length. These were disposed horizontally and represented elongated and enlarged interventricular foramina (Fig. 8). The aqueduct of Sylvius and fourth ventricle were not visible. The basal cisterns appeared normal and the cerebral sulci were not visualized.

Fig. 10. Case III. The lateral ventricles show moderate dilatation, especially the posterior parts of the bodies. The third ventricle is not well visualized in this view. Long, radially disposed sulci (arrows) and convolutions are seen on the mesial aspect of the brain and passing through the area of the brain normally occupied by the horizontally placed cingulate gyri.

Comment. In view of the similarity of the encephalographic findings in this case as compared to Case I, a diagnosis of agenesis of the corpus callosum was made.

Case III. (N.I. No. 15891.) M.S., a white female, aged three, entered the hospital as a private patient of Dr. Charles A. Elsberg, on May 1, 1933.

Complaint. (1) Retarded physical and mental development. (2) Convulsions.

Present Illness. The child had always been retarded in her physical and mental development. She did not walk until nineteen months of age. At the time of admission, at the age of three years, she did not speak with the exception of a few single words. Aside from the retardation she was well until September 5, 1932, when she had a grand mal seizure lasting fifteen minutes. On November 19, 1932, she had a second more severe attack. This was initiated by an upward rotation of the eyes and clonic movements of the right extremities, and lasted two hours. A third convulsion occurred on April 7, 1933.

Family History. Negative. The patient was the first and only child of young parents.

Past History. The child was an eight months, premature infant weighing 4 lb. 13 oz. (2,310 gm.) at birth. She was bottle fed from birth and has always had an easily disturbed digestive system. She has had no illnesses except for acute otitis media at two years of age.

Physical Examination. The patient was a well-nourished but under-developed white female child who screamed and resisted the examiner whenever she was touched. Her gait was normal. The coördination and sensory examination could not be carried out due to lack of cooperation. The deep reflexes were somewhat exaggerated but equal. No pathological reflexes were present. Sensation as far as could be determined was normal. Cranial nerves, including the eyegrounds, were normal. Blood, spinal fluid and urine examinations were negative.

Roentgen Examination (No. 24979). The roentgenograms of the skull showed it to be increased in width, and the coronal suture was obliterated. There was no evidence of increased intracranial pressure or abnormal calcification. The encephalograms presented a bizarre picture. The lateral ventricles were widely separated; by measurements the medial margins of the ventricles were each 2.5 cm. lateral to the midline of the brain. Furthermore, the medial borders of the lateral ventricles were markedly concave. The roofs of the lateral ventricles were pointed and the inferior borders flattened, which is just the reverse of the normal. The third ventricle was enlarged and extended dorsally in the midline between the lateral ventricles, thereby filling the position normally occupied by the inferior portion of the septum pellucidum and the pillars of the fornix (Fig. 9). The basal cisterns were normal in appearance except for the cisterna laminae cinereae terminalis which lacked its normal concavity cephalically and formed a straight line in a dorsoventral direction. Several large sulci were out-

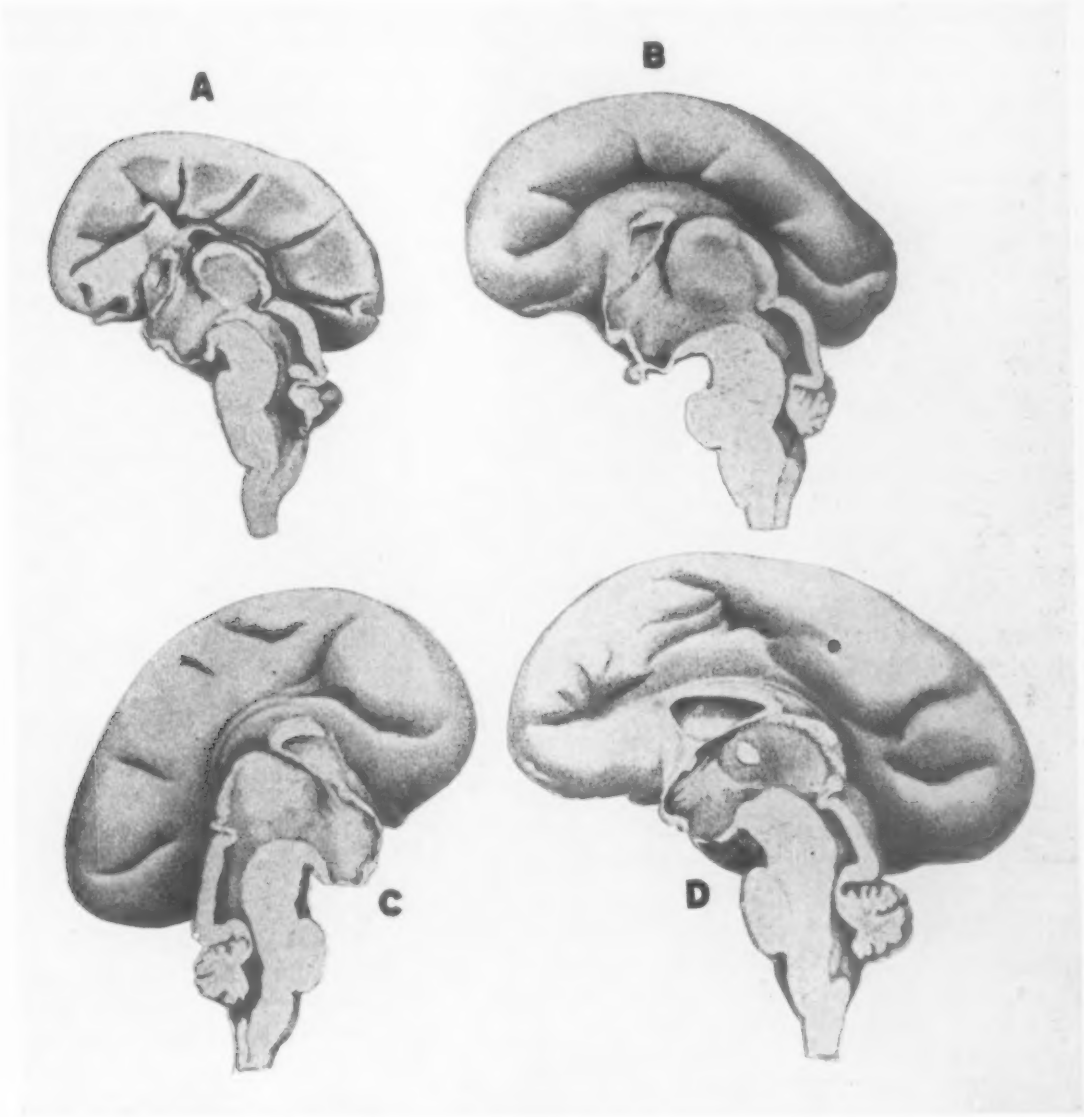

Fig. 11. From Retzius "Das Menschenhirn," Plate LV, Figures 3, 10, 12 and 13. A. End of the third month, 10.5 cm. embryo. Shows a projecting hooklet on the upper part of the lamina terminalis, the angle of which is open inferiorly (arrow). Note the radial arrangement of the mesial sulci. B. A 15 cm. embryo. The anterior end of the hooklet is placed further ventrally and the triangular field is beginning to be framed in. C. and D. 17–19 cm. embryos (fourth to fifth month) showing further stages in the development of the corpus callosum. The radial sulci have become shortened and the horizontal cingulate and callosal sulci and convolutions are indicated. The hooklet is undoubtedly the anlage of the corpus callosum. From these preparations it is apparent that a three-cornered field of the mesial surface of the brain anterior to the upper end of the lamina terminalis becomes enclosed by the corpus callosum and in this way gives rise to the cavity as well as the septum pellucidum. The floor of the cavum is formed by the so-called elongation of the septum pellucidum.

lined by air on the medial aspect of the hemisphere as determined by stereoscopic examination, and these assumed a vertical course, passing vertically through the region normally occupied by the horizontally placed cingulate convolution and the corpus callosum (Fig. 10).

Operation. An exploratory craniotomy was attempted in order to expose the mesial aspect of the brain, but it had to be abandoned due to large anomalous cortical veins which interfered with adequate retraction. The child made an uneventful recovery from the operation.

Comment. Encephalography was performed on this patient prior to verification of the lesion in Case I, and the operation was undertaken on the basis of a mistaken roentgen diagnosis of a cyst of the cavum septi pellucidi. After the post-mortem examination in Case I the diagnosis of agenesis of the corpus callosum in the present case also became evident.

DISCUSSION*

The corpus callosum is formed during the third and fourth months of fetal life. While some embryologists believe that it arises from a fusion of the medial surfaces of the embryonic brain, Retzius has shown that it is an outgrowth of the lamina terminalis. In embryos having reached the end of the third month of intrauterine life, a hooklet projecting cephalically from the dorsal end of the lamina terminalis becomes visible on the mesial surface of the brain. This hooklet is the anlage of the corpus callosum. The angle between this structure and the lamina terminalis is open ventrally and cephalically (Fig. 11, A). At a somewhat later stage the hooklet becomes elongated cephalically and thickened, but remains connected caudally with the lamina terminalis (Fig. 11, B). The anterior end of the hook-shaped structure continues to bend ventrally until it fuses with the dorsal, cephalic portion of the lamina terminalis (Fig. 11, C and D). By the ventral bending, the upper portion of the lamina terminalis becomes enclosed, thus giving rise to the septum pellucidum and its cavity. Before the formation of the corpus callosum, radially arranged, shallow sulci are often visible on the mesial aspects of the embryonic cerebral hemisphere (see Fig. 11, A). Many investigators, especially L. W. Bischoff, believe these to be artefacts produced by shrinkage during the process of hardening, but a group of well-known workers in this field, including Ecker and Retzius, have seen them in fresh embryos, and, together with many other embryologists, believe them to be natural but transitory structures. It would seem, therefore, that the radial arrangement of the convolutions and sulci of the medial aspect of the brain in cases where the corpus callosum is lacking is an anomalous preservation of this primitive, transitory arrangement of these structures occurring prior to the third month of fetal life, before the corpus callosum is formed.

We are inclined toward the latter view since not only is the radial arrangement of convolutions and sulci preserved in cases of complete agenesis of the corpus callosum, but where partial agenesis exists the radial arrangement is absent dorsal to the partially formed corpus callosum, and again preserved where the latter structure has failed to develop.

In order to establish the authenticity of characteristic encephalographic changes in cases of agenesis of the corpus callosum, it was necessary to compare the encephalograms in Case I with the abnormalities seen in the brain from this patient at post-mortem examination. While certain malformations such as the hypoplasia of the right hemisphere accounted for the slight displacement to the right of the entire ventricular system, the other deviations from the normal in the encephalogram coincided with the anomalies of the brain resulting from a failure of the evolution of the corpus callosum.

After the encephalograms in Case I were demonstrated to be characteristic of agenesis of the corpus callosum, a comparison of the films in this case with those of Cases II and III revealed similar changes in the encephalograms in these two patients which we believe to be based on similar fundamental pathological variations.

The cardinal changes noted in the encephalograms of all three cases of agenesis of the corpus callosum which form the subject of this presentation are summarized in Table I. The essential points are: (I)

*This brief and incomplete discussion of the anatomical explanation for the anomaly is offered with apologies to Drs. Tilney and Orton whose extensive study of the morphology and pathology in this condition is to appear in a later publication.

Marked separation of the lateral ventricles; (2) the angular dorsal margins of the lateral ventricles; (3) the concave mesial borders of the lateral ventricles; (4) the dilatation of the caudal portions of the lateral ventricles; (5) the elongation of the interventricular foramina; (6) the dorsal extension and dilatation of the third ventricle; (7) the radial arrangement of the mesial cerebral sulci around the roof of the third ventricle and their extension through the zone usually occupied by the corpus callosum.

TABLE I

ENCEPHALOGRAPHIC EVIDENCE OF AGENESIS OF THE CORPUS CALLOSUM

Case	*Lateral Ventricles*			*Interventricular Foramina*	*Third Ventricle*		
	Position	Shape	Size		Position	Shape	Size
I N.E.	Separated 1.8 cm.	Concave mesially. Dorsal margins pointed	Posterior portion of bodies and temporal horns markedly enlarged. Right frontal horn absent. Left frontal horn rudimentary	Elongated	Slightly to right of midline; between the lateral ventricles; top located 1.3 cm. dorsal to foramen of Monro	In anteroposterior view somewhat triangular with base dorsally. Cocked-hat shape as seen from side	Enlarged. 1.9 cm. in width; 4.5 cm. in height
II E.R.	Separated 4.3 cm.	Concave mesially. Dorsal margins pointed	Frontal horns absent. Posterior portions of bodies markedly dilated. Temporal horns moderately dilated	Elongated	Between the lateral ventricles; separated from each lateral ventricle by 1.0 cm.; top is 1.9 cm. dorsal to foramen of Monro	Cocked-hat shape as seen from side	1.7 cm. in width; 4.7 cm. in height; 5 cm. in length
III M.S.	Separated 5 cm.	Concave mesially. Dorsal margins pointed	Frontal horns narrow. Posterior portions of bodies moderately dilated. Temporal horns slightly dilated	Elongated	Between lateral ventricles; separated from lateral ventricles 1 cm. left; 0.5 cm. on right	Cocked-hat shape as seen from side	1 cm. in width; 3.6 cm. in height

Cerebral Sulci			*Basal Cisterns*			
Position	Shape	Size	Position		Shape	Size
Mesial sulci vertical	Too long mesially	Enlarged anterior to right frontal lobe	Magna:	N.	N.	N.
			Pontis:	N.	N.	N.
			Interpeduncularis:	N.	N.	N.
			Ambiens:		Partially visible	
			Chiasmatis:	N.	N.	N.
			Lamina terminalis:	Too far dorsally	Vertical	N.
Mesial few visible are vertical	Too long mesially	Normal	Magna:		Not visible	
			Pontis:	N.	N.	N.
			Interpeduncularis:	N.	N.	N.
			Ambiens:		Not visible	
			Chiasmatis:		Poorly shown	
			Lamina terminalis:	Too far dorsally	Vertical	N.
Mesial sulci well shown and arranged vertically and diagonally	Too long mesially	Normal	Magna:	N.	N.	N.
			Pontis:	N.	N.	N.
			Interpeduncularis:	N.	N.	N.
			Ambiens:	N.	N.	N.
			Chiasmatis:	N.	N.	N.
			Lamina terminalis:		Not visible	

N.=Normal

SUMMARY

Three cases of agenesis of the corpus callosum are presented with a detailed description of the encephalographic appearance of this anomaly.

The significance of the encephalographic changes in Case I became evident only after post-mortem examination of the brain in this patient.

Cases II and III were diagnosed during life after comparing their encephalograms with those of the first case.

CONCLUSION

Agenesis of the corpus callosum can be diagnosed during life by means of the characteristic findings demonstrated on the encephalogram.

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THE ROENTGENOLIC DIAGNOSIS OF CHRONIC PULMONARY EMPHYSEMA*

By WALTER W. FRAY, M.D.
ROCHESTER, NEW YORK

CHRONIC pulmonary emphysema is seldom included in the roentgen diagnosis of diseases of the chest. Its great frequency is well known, and no additional comment is necessary to bring one to the realization that this represents one of the few forms of pulmonary pathology which can involve the lungs to an extensive degree, and which can markedly impair their physiological efficiency without the roentgenologist being aware of its presence. Many roentgenologists feel that the diagnosis cannot be reliably established by roentgenological means; others require strong supportive clinical evidence before considering the diagnosis.

Textbooks and monographs pay little attention to the differential diagnosis of pulmonary emphysema. In general, each stresses a different differential point without offering any evidence of a comparative character to demonstrate the superior value of the differential feature cited. Among the more valuable suggestions are: (*a*) increased space between heart and sternum (lateral position), which remains essentially unaltered during inspiration and expiration (Köhler);[2] (*b*) low flattened diaphragm with limited mobility (Köhler);[2] (*c*) increased prominence of the pulmonary markings of the peripheral lung zone (Sante);[3] (*d*) general increase in brilliancy of the lung fields (Holmes and Ruggles);[1] (*e*) diaphragmatic folds (Weltz);[5] (*f*) irregular dilatations of bronchi after lipiodol injection (Sparks and Wood).[4] I am aware of no work dealing with the comparative value of these and other signs to be discussed in a group of individuals, the pulmonary pathology of which is well established.

We have been fortunate in studying 52 autopsied cases of emphysema by means of the posteroanterior and the left anterior oblique film. To permit comparison, a similar group of normal cases has been selected from the clinical group (cases still living) in which there was no suspicion of emphysema. A few deaths have occurred in this latter group, and in these, autopsy verified the clinical impression. These also have been examined by means of the posteroanterior and left oblique films.

An analysis of these various criteria, together with several additional features not described hitherto in the literature, will next be discussed and an attempt made to determine their comparative value. For the purpose of this discussion, it is convenient to divide these diagnostic features according to the method of examination and the anatomical regions considered as follows: I. Roentgenoscopic features; abnormalities relating to (1) diaphragm, (2) lung fields, and (3) chest cage. II. Roentgenographic features; abnormalities relating to (1) diaphragm, (2) lung fields, and (3) chest cage.

I. ROENTGENOSCOPIC EXAMINATION

Limitation of Motion of Diaphragm. The movements of the diaphragm are frequently restricted in cases of emphysema. This is, however, a variable feature and is most frequently noted in the more extreme type of cases. It is not a conspicuous or constant characteristic in early cases. Considerable emphysema may be present, without any reliable evidence being found in reference to the diaphragm. This is, in part, due to the fact that diaphragmatic excursion shows wide variations in entirely normal individuals. It will vary rather widely, even after proper allowance is

* From the Department of Medicine, Division of Radiology, of the University of Rochester, School of Medicine and Dentistry, Rochester, N.Y.

made for alterations due to habitus, age, height, weight, and position of the patient. A special study of some of these features, carried out in conjunction with Dr. A. Hurtado (and still in progress), has shown that it is impossible to predict what the excursion of the diaphragm will be in an actual case. This is due to the fact that normal individuals, who do not use their diaphragms, compensate for this lack by a more exaggerated use of the rib cage. The reverse of this is also found in normal cases.

In the present study, 19 of a total of 52 cases showed sufficient limitation to be recognized during the routine roentgenoscopic examination. It should be noted that practically all of these examinations were made by the various members of the Division of Radiology without any special search for the signs of emphysema. It represents, therefore, the results which might be obtained under average conditions. Examination of the pathological changes within the lungs of 5 of the 19 cases demonstrated anatomical changes of a character entirely adequate to account for the limitation of the diaphragm, so that in these, emphysema (though present) was probably not the sole cause for the alterations in diaphragm excursion. In 32 cases the diaphragms either moved normally or the extent of the changes present was not sufficient to be recognized without a more exhaustive study. In 5, the records of the roentgenoscopy failed to give any information concerning the excursion of the diaphragms, or no examination was made. In the normal series of 52 cases, the dynamics of the diaphragm were not remarkable.

Occasional reference is found in the literature of the occurrence of paradoxical movements of the diaphragms in cases of emphysema. True total reversion of diaphragmatic movements is extremely rare. It has not been observed in any cases coming under my observation. A modified form of paradoxical movement is occasionally observed in some of the more severe grades of emphysema. The most common form of this movement is observed when the excursion of the diaphragm is carefully followed by marking the position of the diaphragms at the end of normal and maximal inspiration on the fluoroscopic screen with a wax pencil. One will occasionally be surprised to find that the level of the latter respiratory phase is actually higher than the former. Individuals presenting this abnormality usually employ the rib cage predominantly to effect maximal respiration, and the reversion of these movements is probably due to the effect of the expansion of the rib cage upon the peripheral attachments of the diaphragm.

Change in Radiolucency of Lung Fields during Respiration. The normal lung field during the phases of respiration varies greatly in radiolucency in individuals whose vital capacity is not decreased. This is best brought out by forced breathing, requesting the patient to first exhale vigorously, noting the intensity of fluorescence of the screen, and immediately following the expiration by a deep inspiration. A marked lighting up of the screen during the inspiratory phase is a constant feature which is seen in all normal subjects, and with practice, considerable skill may be gained in detecting variations and in separating the normal from the pathological cases. This increased brilliancy of the screen is better observed over the lower half of the lung field, although the same change, less marked in degree, is apparent even over the normal apex.

An important feature of emphysema relates to the absence of, or often decrease in, this normal intensification of the fluorescent screen during inspiration. This is an important roentgenoscopic sign, but is usually omitted from the report of the routine examination of the chest. In fact, it is usually not discussed in the textbooks or monographs dealing with the roentgen examination of the chest. Barjon (1918) is a noteworthy exception. Our printed form for chest roentgenoscopy has no provision for its record, and we are unable, in

the present study, to give reliable data concerning the incidence of this sign in our series. It has been, however, a constant sign in some of the cases of this series which I have observed. It is probably a very reliable sign in the more advanced cases, but cannot be expected to give any quantitative information and cannot be relied upon for the recognition of early cases of emphysema. When present, it is indicative of a diminished vital capacity rather than an increase in the residual air—the characteristic change of emphysema.

Another roentgenoscopic sign of some value, which has not been described to my knowledge, relates to the degree of airlessness at the lung bases at the end of maximum expiration. In a normal case, one in which the residual air is not increased, the diaphragm will ascend and the chest cage contract to such an extent that the lung bases have a nearly airless appearance, similar to that of a more or less solid organ. It usually appears more marked on the left side. This results in a partial or total obliteration of the shadow of the diaphragm on this side. It may be impossible to visualize the left diaphragm during roentgenoscopy at the end of a maximum expiration. This is a striking finding in normal cases, and it is believed that it constitutes a valuable sign in obtaining information concerning the amount of residual air in the lungs. In cases of emphysema, it is a common finding to note that the diaphragms remain brilliantly outlined even at the end of a maximum expiration, which finds its physiological explanation in an increase in the residual air of the lungs. The length of time required to accomplish this phase of respiration is also prolonged in cases of emphysema. Roentgenoscopically, increases from four to six times normal may be noted.

Changes in Chest Cage. A limitation in chest mobility during respiration may be evident on roentgenoscopic examination, but because of the size of the roentgenoscopic field to be followed by the eye, if the entire chest is to be studied, an imperfect impression of this point may be obtained. Both the mobility of the chest cage and of the diaphragms can be obtained to better advantage by means of a double exposure technique, which will be discussed in a subsequent communication and which yields quantitative information concerning these features.

In summary of the roentgenoscopic features of emphysema, we may state that (*a*) the decreased vital capacity often seen in cases of emphysema is indicated by the slight change or absence of change in radiolucency of the lung fields during the various phases of respiration; (*b*) the increase in residual air is indicated by the well and easily visualized diaphragms at the end of maximum expiration, due to the unusually large air content of the lung bases, even after an extreme effort of expulsion of this air during expiration; (*c*) relative fixation of the chest cage, and (*d*) decreased mobility of the diaphragms in many cases. The latter two are undoubtedly associated with the alterations observed in the lung field noted under (*a*) and (*b*), and are casually interrelated.

The other diagnostic features of emphysema are studied to better advantage from the roentgenographic examination. The roentgenoscopic study, however, should form a most important part of the chest examination.

II. ROENTGENOGRAPHIC FEATURES

Changes in Chest Cage. Every clinician is familiar with the classical or characteristic deformities of the chest cage observed in cases of emphysema. Can any clue to these alterations in the diameters of the chest be obtained by roentgenologic means? The literature with which I am familiar gives little aid in this regard. Several years ago (1929) I was surprised to find, in measuring the diameters of the chest (incident to cardiac mensuration), that the transverse diameter of the left anterior oblique film actually exceeded the same diameter of the posteroanterior film at the same level. A check proved that no error

in films had been made, both films belonging to the same patient. Since then, we have had abundant proof that this condition is not infrequently found in cases of emphysema, and that it is undoubtedly related to the deformity of the thorax observed clinically. All the thoraces of the normal and emphysema groups have been analyzed from this standpoint, after measuring the transverse diameters of the posteroanterior and left anterior oblique chest films at two different levels—the base and apex of the heart. The selection of two different levels was believed to be advisable, since chests vary widely in general shape and a given change might be more readily detected at one level than at another. Figures 1 and 2 illustrate the method used in making these measurements.

When the normal chest is rotated, the transverse diameters are found to progressively decrease as the angle of rotation is increased. The manner in which these changes occur can be seen at a glance by the examination of Table 1, the measurements of which were obtained from a young, healthy adult male.

It will be noted that as the chest is rotated through each successive 15°, the transverse diameter decreases and that this change is slight at first but becomes pronounced and is at its maximum at the middle of the series, i.e., 45–60°. There undoubtedly would be minor changes with different normal chests, but there would be agreement in regard to the general trend. To determine this latter point, the entire normal series of 52 cases have been measured, obtaining the transverse diameter of the chest at the level of the base of the heart and at the apex level. An index is obtained by dividing the transverse diameter of the posteroanterior film by the transverse diameter of the left oblique film (taken at approximately 45° rotation). This was done for both levels (base of heart and cardiac apex). Indices above 1.0 would indicate that the transverse diameter has decreased with rotation, while the opposite would be true if the indices were below 1.0. In all cases of the normal series, with two exceptions, the index was above 1.0 when the transverse diameter of the chest at the level of the base of the heart is considered. When the transverse diameter was taken at the level of the cardiac apex, there is a single exception. The average index for the transverse diameter (level of base of heart) was found to be 1.10, with a range of variations from 0.96 to 1.26. Comparison of values of these indices in the emphysema cases is very interesting in showing a much lower average index of 0.96, with a range of values from 0.85 to 1.07.

Table I

TRANSVERSE DIAMETERS AS CHEST IS ROTATED FROM POSTEROANTERIOR TO THE LATERAL POSITION

	Postero-anterior	15°	30°	45°	60°	75°	90°
Transverse diameter (base of heart)	27.7	26.1	25.2	23.0	19.2	17.2	
Transverse diameter (apex of heart)	30.0	28.1	27.2	23.7	19.0	17.8	
Change in transverse diameter (base of heart)		1.6	0.9	2.2	3.8	2.0	
Change in transverse diameter (apex of heart)		1.9	0.9	3.5	4.9	2.8	

When the index is applied to the transverse diameter taken at the level of the cardiac apex, similar results are obtained with an average index of 1.14 for the normal series, and 1.04 for the group of emphysema cases (41 observations). The range for the normal series extended from 0.91 to 1.31, and from 0.86 to 1.17 for the emphysema group. From an examination of Table II it becomes apparent that either of the two levels may be selected in measuring the transverse diameter of the chest, but the higher level is probably the more reliable because it differentiates the normal from the pathological more sharply. Thus, if one selects a range of 1.05 or above as indicative of the normal chest, and those below this as indicative of the emphysematous chest, we find that we have correctly separated the two groups with the exception of 11 normal cases and 3 cases of emphysema. Values between 1.03 and 1.05 represent the range of doubtful results, while a figure below 1.03 is strongly suggestive of emphysema and one above this range (1.05) a normal chest.

When the index is obtained by selecting a transverse diameter at the level of the cardiac apex, there is more scattering as regards the range and a less sharp separation of the two groups. Thus, selecting a range of 1.10 or above as normal, and a value below this figure as abnormal, we find 11 normal chests and 6 abnormal chests falling outside these ranges.

TABLE II

COMPARISON OF NORMAL AND EMPHYSEMA GROUPS

	Normal	Emphysema
Average index transverse diameter of chest (base of heart level)	1.10	0.96
Range	0.96–1.26	0.85–1.07
Average index transverse diameter of chest (cardiac apex level)	1.14	1.04
Range	0.91–1.31	0.86–1.17
Rib angle	59°	56°
Range	50–68°	41–76°
Width of intercostal space	2.9 cm.	2.9 cm.
Range	2.3–3.8 cm.	1.5–3.7 cm.
Bulging of lower thorax	23%	77%
Limited diaphragmatic excursion	0%	37%
Low diaphragm	1%	36%
Increased brilliancy of lung fields	0.6%	21%
Increased lung markings	65%	100%

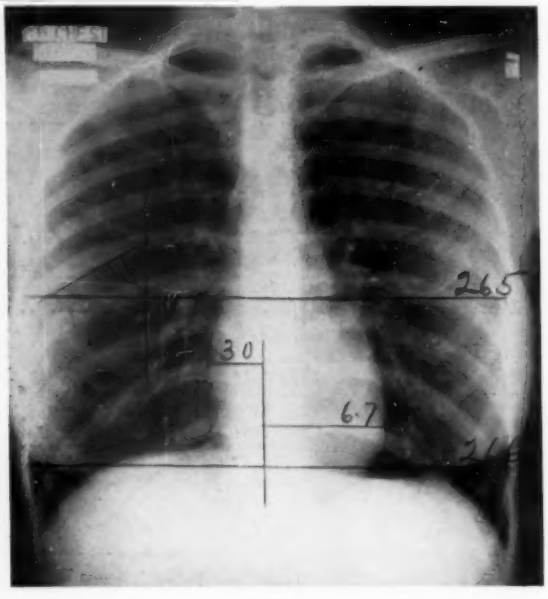
The findings in the present series would indicate that the transverse diameter is preferably made at the level of the base of the heart. Occasionally we may find that the other measurement may be helpful as a supplementary check.

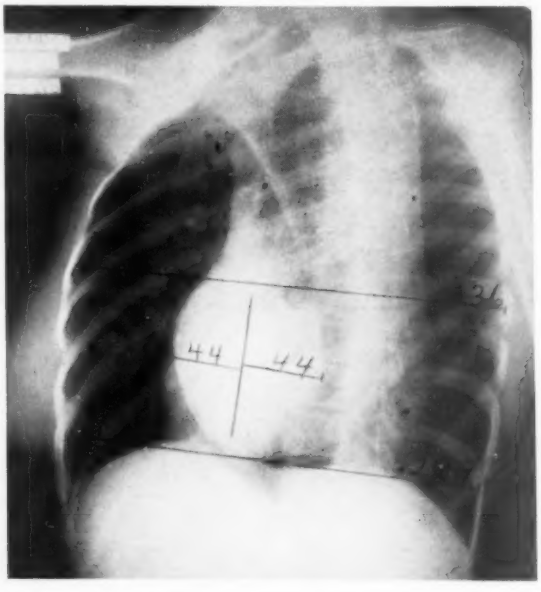
In summarizing these findings of the index taken at this level, we may state that an index below 1.0 is strong evidence of a deformed thorax, and that we should search further for the cause. Not all cases of emphysema show an index below 1.0—many of them ranging from 1.0 to 1.05. In

these, the other signs of emphysema should be taken into consideration in determining the presence or absence of emphysema. An index above 1.10 is strong evidence of a thorax of normal proportions and emphysema, if present, has not greatly modified the configuration of the thorax. This sign should not be considered an early sign, since actual chest deformity must be present before it is observed. It is, however, a sign which may be extremely helpful when chronic passive congestion, edema, pneumonic consolidation, etc., obscure the lung fields, thus preventing the determination of many of the other signs of emphysema.

There are several other changes relating to the thorax, or more strictly to the ribs, which are often mentioned in the literature as being due to emphysema. These are: (1) the high, elevated appearance of ribs resulting in horizontal position of these structures; (2) increased width of the intercostal spaces. A third, rib bulging or flaring, is not an infrequent observation which was made in this series. This bulging is noted over the lower axillary regions of the posteroanterior film. All three of these impart to the thorax an appearance of extreme inflation.

Rib Angle. In determining the value of the first one of these, the rib angle was determined in the following fashion. A line parallel to the spine was drawn half way between the spine and the axilla. The general slope of the posterior portion of the rib was next ascertained by drawing a line from the rib center at the axilla and at the line just erected, as shown in Figure 1. The angle formed by these two lines was measured. Since no figures are available for this angle in normal cases, our series of adult cases (33) were analyzed from this



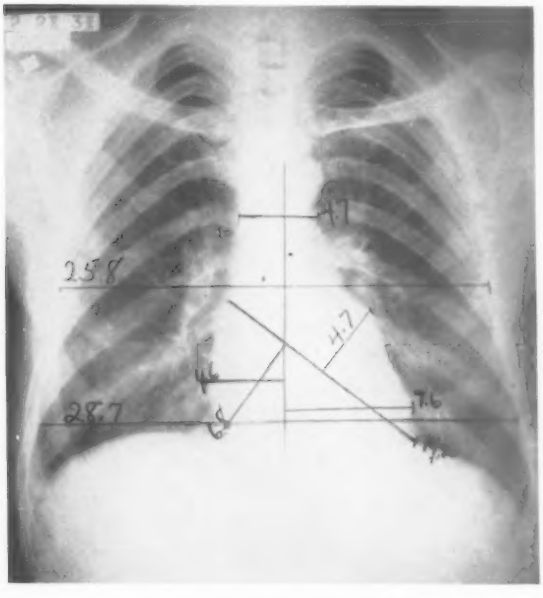


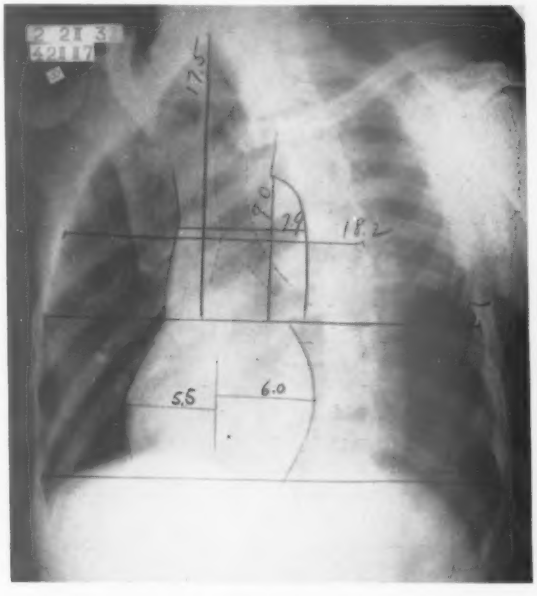
Figs. 1 and 2. Posteroanterior and left oblique roentgenograms of the chest of a normal young adult female. The two transverse diameters of the chest are obtained at the level of the cardiac apex and base. It will be observed that the diameters of the left oblique film are considerably less than those of the posteroanterior, giving an index above 1.0 (1.16 for level of cardiac apex and 1.12 for level of cardiac base). The slope of the rib has been obtained by drawing a line parallel to the mid-plane of the chest, half way between the center of the spine and the axilla, and a second one, representing the rib plane, from the middle of the sixth rib at the axilla to the middle of the rib at the perpendicular line. The angle in the present instance is 60°. The width of the interspace is also determined at this perpendicular line, midway between the spine center and the axilla.

viewpoint. The average value of this was found to be 59°, with individual variations extending from 50 to 68°. In the group of emphysema cases, the average angle was 56°, with variation in individual cases ranging from 41 to 76°. There is a greater range in the group of emphysema cases with both higher and lower values than are found in the normal group. As far as its use as a differential feature is concerned, it has no particular value.

Width of Intercostal Space. The width of the space was measured at the line drawn parallel to the spine, the two ribs selected being approximately half way between the apex and the base of the lung. The average width of the group of normal cases (33 adults) was determined to be 2.9 cm., with a range of 2.3 to 3.8 cm. In the group of cases showing emphysema (50 observations) the average proved to be identical, 2.9 cm., with a range of 1.5 to 3.7 cm. Again as regards the width of the intercostal space, the emphysema group showed greater variability, a greater range in examining individual cases, but as a differential characteristic it possesses little value in spite of the frequent references in the literature to the contrary.

Rib Bulging or Flaring. By this term is meant an abnormal enlargement of the lower thoracic cage. As one follows down the axillary regions of the posteroanterior chest film, the thorax presents a slight bulge, suggesting that several of the lower ribs have been displaced outward—out of the alinement of the adjacent ribs—as though an attempt had been made to increase the size of the thoracic cavity. This change was observed frequently in the group of emphysema cases (40 of 52 observations), although in many it was not pronounced. It is true, however, that normal cases, if the inspiration is particularly vigorous, may show this same change in approximately one-fourth of the cases (12 out of 52 cases). If the bulging of the lower thoracic cage persists with the expiration phase, it



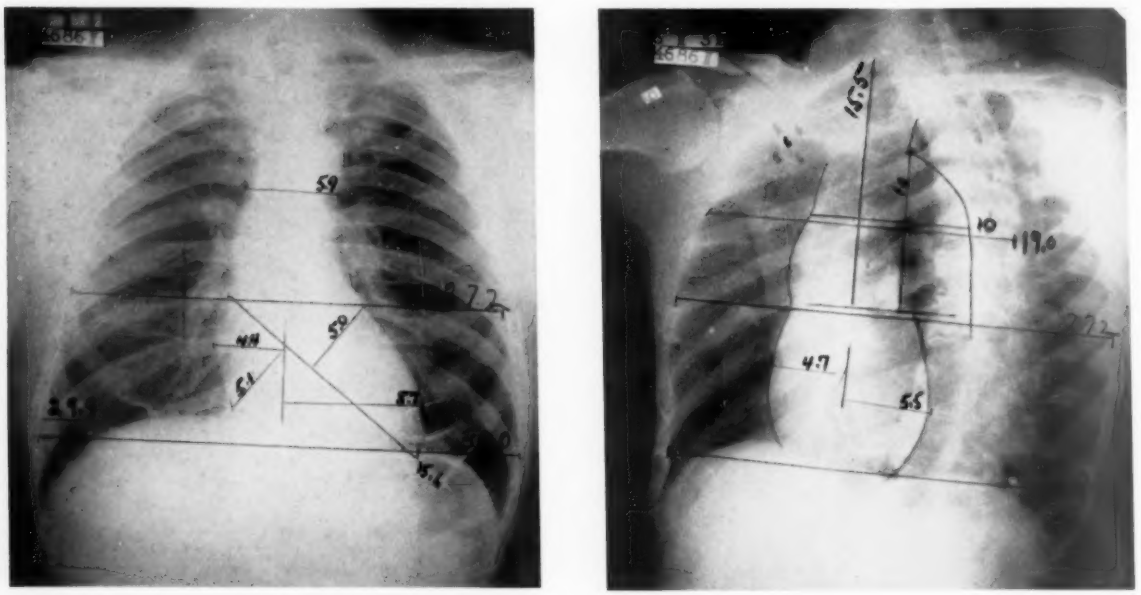


Figs. 3 and 4. Posteroanterior and left oblique roentgenograms illustrating low chest indices, rib flaring, and some increase in the radiolucency of the lungs. The emphysema which this individual showed at autopsy would be missed if one were to rely on the slope of the ribs or the width of the interspaces. The transverse diameter of the left oblique chest at the level of the base of the heart (26.5 cm.) exceeds the same diameter of the posteroanterior roentgenogram (25.8 cm.), yielding an index of less than 1.0.

is a strong indication of emphysema, since it suggests that a permanent alteration in the chest cage has been produced. Vigorous adults with a high vital capacity, who possess strong muscular control over the costal muscles, will very frequently show a perceptible bulge at the lower thorax with full inspiration. This is an indication of a mobile chest cage affected by vigorous muscular action. It disappears as soon as these muscles relax, while in cases of emphysema this persists after the relaxation of the muscles used in forced inspiration.

the ribs show a marked slope, and that the rib interspaces are not increased. Emphysema will be missed very frequently if these latter two criteria are accepted as guides. At autopsy, nine months later, in addition to the emphysema there were found infarcts, atelectasis of the lungs, and a pulmonary sclerosis of the branches of the pulmonary arteries.

Figures 5 and 6 represent similar changes in the chest of a man, aged fifty-seven, who entered the hospital with a history relating to a duodenal ulcer. His chest, on



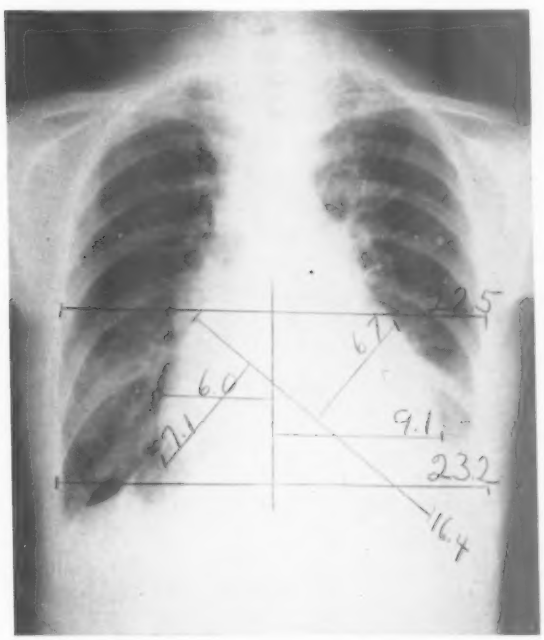
Figs. 5 and 6. Illustrating a case of emphysema (male aged fifty-seven), in which the transverse diameters of the chest (level of cardiac base) of the posteroanterior and left oblique roentgenograms are equal. There is also a slight rib bulging and relatively low diaphragms. There is nothing remarkable, either about the slope of the ribs or the width of the interspaces, to attract attention to the proper diagnosis of pulmonary emphysema.

Rib bulging is illustrated in Figure 3. This is a posteroanterior film of a male, aged forty-five, who entered the hospital with symptoms relating to a vegetative endocarditis. The lungs were found essentially normal on physical examination. The roentgenograms (Figs. 3 and 4) of his chest reveal changes relating to emphysema: low ratios for the diameters of the chest, 98 (apex) and 103 (base), rib flaring, and a generalized increase in the radioluency of the lung fields. It will be noted that

physical examination, was not remarkable, except for a few râles at the right base. The roentgen evidences of emphysema are a low index (1.0), slight rib bulging, and slightly low diaphragms. The slope of the rib (59°) is normal, and the width of the rib interspaces does not appear increased. He died three days following the roentgen examination, and at autopsy the roentgen finding of emphysema was verified.

Position of Diaphragms. The diaphragm of emphysema is often described as low,

flat, and associated with shallow costophrenic angles. References of this type are numerous in the literature. Our study has proved most interesting in this connection. In 52 autopsied cases of emphysema, the diaphragms were noted to be low in only 19 instances, and in 9 of these the change was slight. In 2 of the cases the diaphragm was actually high. In the normal series the diaphragm was noted to be low in 6 and high in 2 out of the 52 cases. The flattening of the diaphragms and the shallow costophrenic angles are both changes associated with the low position of the diaphragms, and require no additional comment or analysis. The low position of the diaphragms, since it is absent in over one-half of the cases of this series, does not appear to be a particularly valuable sign in itself.



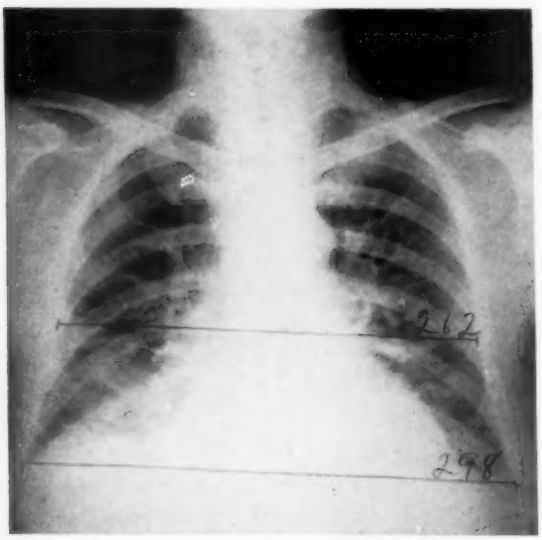
Figs. 7 and 8. Roentgenograms of white female, aged twenty-five, who died as the result of right heart failure due to an extensive pulmonary fibrosis and emphysema. The transverse diameters of the oblique position exceed those of the posteroanterior position. Brilliant local areas of increased radiolucency are observed over the right lung field. The rib spaces are wider than average, but the ribs are not of the horizontal type.

The roentgenograms of the following case of pulmonary fibrosis illustrate this point (Figs. 7 and 8). This young woman, aged twenty-five, entered the hospital complaining of dyspnea, edema of ankles, and palpitation. Clinically it was believed that her clinical picture was due to rheumatic heart disease with myocardial insufficiency. At autopsy she showed marked right heart dilatation and hypertrophy secondary to the pulmonary fibrosis associated with emphysema. The diaphragms are not low in position, but the low index of the chest (0.98) and local areas of increased radiolucency are indicative of emphysema. The wide prominent arc of the right border of the heart (left oblique position) suggests the marked enlargement of the right side of the heart which was observed at autopsy. The apex of the heart of this case was composed of the right ventricle.

Increase in Brilliancy of Lung Fields. The usual chest film is taken at the end of a fairly complete inspiration (without straining). Numerous references are found in the literature relating to the increased radiolucency of the lung fields in cases of

emphysema. At times, local areas of the lung field may be picked as excessively brilliant. Emphysematous blebs may be identified. It is surprising, however, in following chest pathology at autopsy to note the very frequent incidence of massive areas of emphysema over the upper lobes, when no clue of it can be obtained from the chest film even on re-inspection. It must be admitted that this sign is often absent, and when present is usually indicative of an advanced case of emphysema. Different explanations have been given for the presence of this roentgenologic feature. Some have felt that the increased radiolucency is the result of an actual increase in the total lung volume. This conclusion is more the result of conjecture than of established fact. Recent work carried out by Anthony, Hurtado, and others, indicates that this is probably not the case—the total lung volume in cases of emphysema is not materially increased and an explanation of the increased radiolucency is found in the decreased vascularity of the lungs. The capillary bed in emphysematous areas is narrowed, cutting down the blood supply to these areas, and since blood is relatively radiopaque, a decrease in the vascularity would tend to make these areas abnormally radiolucent. The blood content of the lungs undoubtedly determines, to an important and significant degree, the relative radiopacity of the lungs, and may readily account for the roentgen changes observed in some cases.

Many cases of emphysema fail to show this sign. In our series of 52 cases of emphysema it was observed 12 times. Emphysema comes at an age period when cardiac disease is frequent, and many of the cases of this series were suffering from decompensated hearts. The chronic passive congestion and edema of the lungs thus produced tends to obscure this sign. Of those cases which did not show this sign (44), chronic passive congestion or edema was found in 18. It is quite possible that



Figs. 9 and 10. Case of chronic emphysema, associated with chronic passive congestion of the lungs. Elderly male, aged seventy-four, with symptoms relating to arteriosclerotic and hypertensive heart disease. The changes due to chronic passive congestion obscure the lung fields to such an extent that the criteria for a diagnosis of emphysema must be based upon abnormalities relating to the chest cage. When these criteria are employed, the diagnosis is established by the low chest indices of 0.99 and 1.03, and by the rib bulging. Other criteria, such as position of the diaphragm and ribs, and width of the interspaces, are misleading if reliance is placed upon them.

some of these would have shown this sign if conditions had been more favorable. The fact, however, that cardiac decompensation is so often found coincident with emphysema emphasizes the need for additional and more reliable evidence of this condition.

Figures 9 and 10 represent the roentgenograms of an elderly man, aged seventy-four, who entered the hospital with symptoms relating to arteriosclerotic and hypertensive heart disease. The lung bases showed numerous moist râles. The changes due to chronic passive congestion obscured large areas of both lung fields. The presence of emphysema is suggested, however, by the alteration in the diameter of the chest (low indices of 0.99 and 1.03) and by the rib bulging. The slope of the rib, the width of the rib spaces, and the position of the diaphragms are of no value as criteria in this case. At autopsy (several weeks after taking the films) a broncho-pneumonia was found in addition to the emphysema and chronic passive congestion.

Accentuated Lung Markings. A variable degree of pulmonary fibrosis commonly develops during the course of chronic, nonobstructive emphysema. Sante calls attention to the intensified markings in the peripheral zone of the lungs. In severe cases this fibrosis may involve all zones of the lung. It should be differentiated from other conditions, such as chronic passive congestion which also produces increased markings of the lungs. Fibrosis on a properly exposed film (without motion) appears as dense, sharply delineated shadows, which ramify radially toward the periphery of the lung, while chronic passive congestion produces shadows of a soft, ill-defined character, with an associated beading of the linear markings or mottling of the lung fields, together with considerable or marked enlargement of the hila. An anatomical basis for this difference in appearance is not difficult to find: In chronic passive congestion the blood vessels are engorged with blood (it is this which produces the prominent markings of the chest film), while in emphysema the size of the vascular bed is materially cut down and the blood flow through such areas is diminished. It is this avascularity which produces the pale, downy appearance of the lung. The intensified markings, therefore, are actually due to fibrosis itself, while the vascular bed is less responsible for the lung markings than in normal cases. To prevent errors in interpretation, a film free of blood vessel motion is imperative. Fibrosis may simulate other conditions if the slightest motion is present, the sharply delineated shadows of fibrosis becoming ill defined and indistinct, permitting confusion with such conditions as chronic passive congestion. After eliminating the 18 cases which showed evidence of chronic passive congestion at autopsy, all 18 of the remaining ones showed evidence of intensified lung markings. It is evident that intensification of lung markings is associated with emphysema.

SUMMARY AND CONCLUSIONS

The diagnosis of pulmonary emphysema can be successfully established by roentgenologic means alone. Both the roentgenoscopic and roentgenographic examinations contribute materially in making this diagnosis. Of particular importance are the roentgenoscopic observations because these give definite information concerning the physiological impairment of pulmonary ventilation—determinations which can never be made by any analysis of shadows on the roentgenogram.

During roentgenoscopy, much significance can be attached to the permanent or unchanging character of the radiolucency of the lung fields during the respiratory cycle, and the clear definition of the diaphragms at the end of a maximum expiration. The former is indicative of a diminished vital capacity, while the latter is particularly valuable because it imparts information concerning the increased volume of residual air. The great importance of this finding is recognized at once when one considers the well-known finding that

emphysema differs from other pulmonary conditions in a definite and constant increase in the residual air.

Restricted mobility of the diaphragms is of minor importance. It is often absent and even when present may be due to conditions other than emphysema. Limited respiratory excursion, however, may serve as an auxiliary aid in pointing to the need for a complete and thorough roentgenoscopy of the chest, with particular attention directed to the other two signs mentioned above.

The roentgenographic findings of emphysema are numerous. Some of these show marked variability in occurrence; others can be shown to be of very doubtful value. Probably the most constant of all roentgenographic signs relates to the low thoracic index of the chest. This sign, of course, is found only after a pathological alteration of the chest contour has occurred. It cannot be expected to identify the early stages of the disease. It is most reliable, however, when chronic passive congestion, edema, and pulmonary consolidation have occurred, which tend to obscure the lung field, preventing the recognition of the other roentgenographic signs.

Thoracic bulging or flaring is another fairly constant finding in emphysema, being noted in over three-fourths of the present series. It is true that normal cases may show a similar bulging of the low thorax at the end of a maximum inspiration, but this disappears promptly when the accessory muscles of forced inspiration are relaxed.

Increased brilliancy of the lung fields is not a particularly reliable sign. It is observed in less than one-fourth of our cases, and it is apparent that many chests which show normal radiolucency have indisputable evidence of emphysema. Local areas of increased radiolucency are probably more certain evidence of emphysema than if the radiolucency is generalized. The detection of emphysematous blebs or the formation of localized pneumothoraces from their rupture is certain evidence of this condition.

The lung markings are so frequently increased in pulmonary conditions other than emphysema that I do not feel that this finding is of great value. If these markings are of such a character that the shadows can be definitely recognized as a fibrosis, the finding is of some value, since pulmonary fibrosis and emphysema are so frequently associated. Simple intensification or exaggeration of normal lung markings is of no importance. If errors are to be avoided, one must identify a network of fibrosis separate and distinct from the usual linear marking, even though the latter may be grossly exaggerated. This is difficult in many cases as a result of blood vessel motion, and this finding would indicate that greater precision might be effected if roentgenograms could be timed in reference to a given phase of the cardiac cycle.

Approximately one-third of our cases presented low diaphragms. This leaves a substantial majority in which this sign is absent, and it can hardly be accorded a high place in the differential diagnosis. When present, its chief value lies in calling attention to the necessity of a search for and analysis of the other signs of emphysema.

In spite of the frequent references to the value of rib position in determining the presence of emphysema, our results would indicate that neither rib position nor width of the intercostal space is of any differential value in the establishment of this diagnosis.

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MEDIASTINITIS*

By KARL KORNBLUM, M.D., *and* LESLIE H. OSMOND, M.D.
PHILADELPHIA, PENNSYLVANIA

THE roentgenological examination of the chest affords the best means of detecting disease within the mediastinum. The recognition of the nature of such disease, however, offers considerable difficulty. The numerous pathological processes that occur in the mediastinum present roentgenologic appearances that closely resemble each other. Variations in size, shape and position are usually insufficient upon which to base a diagnosis. It is only after a most careful consideration of the clinical manifestations and laboratory studies that one can interpret with any degree of accuracy the abnormal mediastinal shadows encountered upon the roentgenogram.

Mediastinal disease is either inflammatory or neoplastic in nature, and is usually primarily concerned with the structures that occupy this space. It should be remembered, however, that in addition to the various structures enclosed within the mediastinum, there is to be found a certain amount of loose areolar tissue with its blood, lymph and nerve supply. This areolar tissue acts as a supportive structure and serves to fill in the space not occupied by the various contents of the mediastinum. This tissue may in itself be the seat of an inflammatory or neoplastic disease. When involved by an inflammatory process the condition is known as mediastinitis.

ANATOMICAL CONSIDERATIONS

For a proper understanding of the manner and ease with which infections may either enter or leave the mediastinum one must consider for a moment some of the anatomical peculiarities of this potential space. Lambert and Berry,[20] from their embryological and anatomical studies, have rather clearly indicated the paths of extension of an infection arising within the mediastinum. This portion of the chest is continuous above with the base of the neck (Fig. 1). There is no true separation; a plane extending from the upper surface of the first dorsal vertebra to the top of the sternum acts as an arbitrary boundary. Thus it is found that inflammatory lesions originating in the neck frequently make their way downward into the mediastinum, and likewise a mediastinitis may invade the neck from below. Lesions between the skin and the superficial fascia cannot invade the mediastinum directly, as the superficial fascia finds firm attachment to the clavicles and upper border of the sternum. In a similar manner, a direct communication is to be found between the mediastinum and the retroperitoneal tissues. This communication is by way of the openings for the esophagus, aorta and splanchnic nerves as they pass through the diaphragm. Infection may thus extend in either direction and originate or terminate as a mediastinitis.

Posteriorly the mediastinum is in direct communication with the areolar tissue which separates the parietal pleura from the sides of the vertebrae (Fig. 2). While the parietal pleura finds a rather firm attachment along the line of articulation of the ribs with the vertebrae, it is, nevertheless, possible for an infectious process to extend from the mediastinum posteriorly and laterally and thus strip the parietal pleura away from the chest wall (Case VIII). A similar condition exists anteriorly where the mediastinum comes in direct communication with the space between the ribs and the parietal pleura. The firm attachment of the pleura to the costal cartilages, however, offers considerable resistance to the extension of an inflammatory process in this direction.

Laterally the mediastinum comes into communication with the lung by way of

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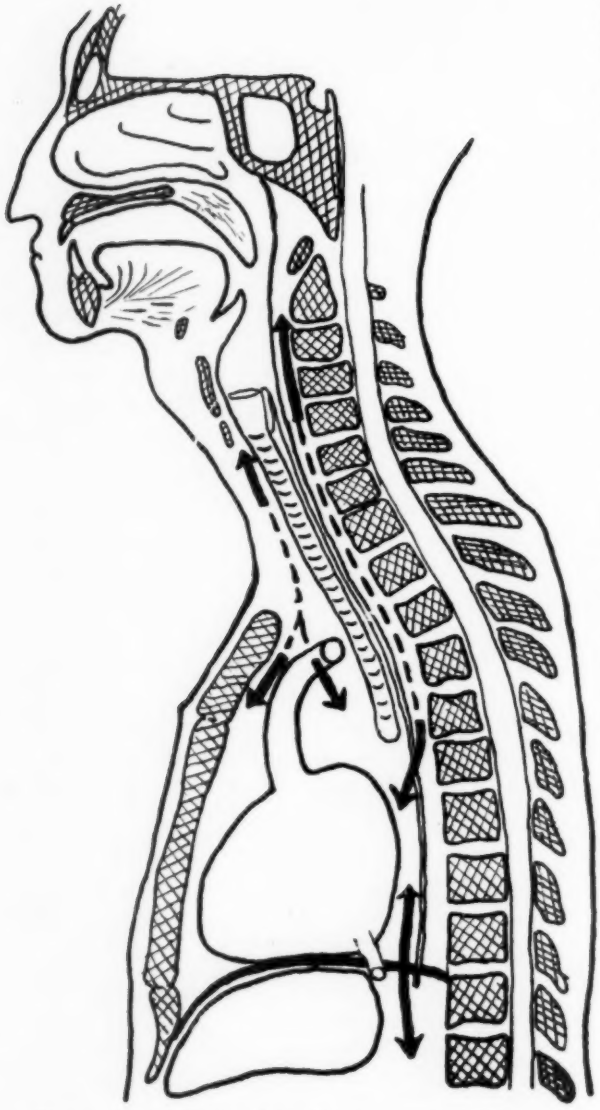


Fig. 1. Diagram showing direct communication with the tissue lying between the superficial and the prevertebral fascias of the neck and the mediastinum; between the retroperitoneal tissues and the mediastinum.

the hilus. The mediastinal areolar tissue is a direct continuation of the connective tissue that accompanies the bronchi and pulmonary vessels. Involvement of this portion of the lung is a common accompaniment of a mediastinitis. Instead of following the course of the bronchi and vessels the infection may spread subpleurally beneath the visceral pleura, giving rise to a pleurisy. Of peculiar interest is the communication of the mediastinum with the lung by way of the pulmonary or so-called broad ligament of the lung. Extending downward from the hilus to the diaphragm, but not attached thereto, is a double layer of pleura, one from the anterior and one from the posterior part of the mesial aspect of the lung which is reflected medially to again pass anteriorly and posteriorly respectively as the mediastinal pleura. The two layers of pleura, which constitute the broad ligament, are separated from each other by a small amount of areolar tissue. This communicates medially with the mediastinum and laterally with the subpleural connective tissue of the lung. Thus, again, infection may extend from the mediastinum laterally through the pulmonary ligament to involve the surface of the lung beneath the visceral pleura.

An understanding of the above anatomical arrangements of the mediastinum permits one to appreciate the various complications that may arise in the course of a mediastinitis, and serves to explain the complex clinical picture presented by many of these cases.

ETIOLOGY

Mediastinitis as a primary disease is relatively uncommon. The affection usually arises secondary to some focus of infection elsewhere. The manner in which the mediastinum becomes involved may be either by trauma, metastasis or extension. External trauma to the chest, such as a gunshot or stab wound or blow resulting in fracture of the sternum or adjacent costal cartilage, may give rise to a mediastinitis. Probably of more frequent occurrence is trauma incident to foreign bodies in the esophagus, less commonly in the trachea or bronchi. In this category must be mentioned trauma resulting from instrumentation of the esophagus, trachea and bronchi and surgical invasion of the mediastinum as occurs in the removal of a substernal extension of an enlarged thyroid. Traumatic mediastinitis, while not the most frequent variety, is probably the most

important, since this type is likely to give rise to an acute mediastinal abscess, which is always a serious complication.

Metastatic or hematogenous mediastinitis is the least common variety and also the least important since the primary disease from which the metastasis occurs usually dominates the clinical picture. As a matter of fact, the mediastinal involvement under such circumstances is rarely recognized clinically. Abscess formation does not often occur. This type of mediastinitis has been encountered in the course of erysipelas, variola, typhoid fever and acute rheumatic fever.[1,9,12,28]

Mediastinitis by extension is by far the most common method of involvement. The mediastinal lymph nodes are a potent source from which infection may spread to the surrounding areolar tissue. The importance of these nodes as foci of infection has been emphasized by Lerche.[22] He has shown that the localization of the infection is dependent upon the particular group of tracheobronchial glands involved. He believes that influenza is frequently followed by suppuration of the mediastinal lymph nodes resulting in a localized mediastinitis. In 3 cases reported by him the onset of the disease had its origin in an attack of influenza.

While the lymph nodes are the most frequent source of infection of the mediastinal areolar tissue, this may occur from any of the structures in or adjacent to the mediastinum. Thus the pericardium may act in this manner and a mediastinitis is found to be a frequent accompaniment of a pericarditis. Infection may extend also from the trachea, bronchi or esophagus. Carcinoma of the esophagus, which frequently ulcerates into the mediastinum, may readily give rise to a localized inflammatory process. Osteomyelitis of the sternum, ribs, or vertebrae, or a chondritis of the costal cartilages may serve as the primary focus. Extension may occur from the pleura and lungs. Mediastinitis is not uncommon in pneumonia. Dunham[8] found 67 cases of acute mediastinal infection in 531 necropsies of patients who died within four weeks after an empyema was recognized. Thirty-five of these had a pericarditis and 8 had a peritonitis.

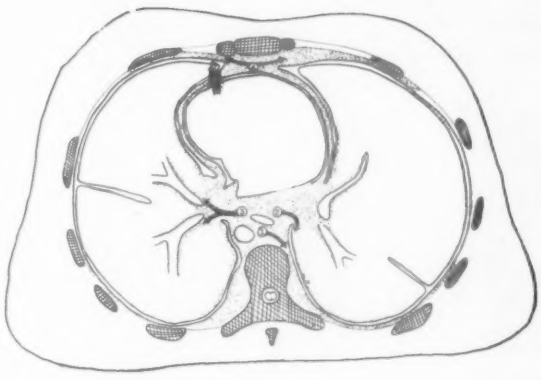


Fig. 2. Diagram of cross section of the chest at level of hila of lungs showing paths of extension of an infection from a focus in the mediastinum: 1. Posteriorly around the body of the vertebra and then laterally between the parietal pleura and the ribs. 2. Laterally by way of the hilus to the subpleural areolar tissue of the lung. 3. Along the larger bronchi and vessels into the lung. 4. From the anterior mediastinum outward between the parietal pleura and the ribs.

Finally, extension may occur downward from the neck and is not uncommon from prevertebral lesions and infection from the trachea, larynx and cervical esophagus. Extension upward from the abdomen may occur in two ways: The infection may spread up along the aorta or esophagus from the retroperitoneal structures or it may pass from the peritoneal cavity through the diaphragm by way of the lymphatics.

There is no age, sex or race predilection. Mediastinitis of traumatic origin would appear to be somewhat more common in the male, being more subject to injury than the female. Various types of organisms may be responsible for the infection. In suppurative lesions the streptococcus or staphylococcus is usually found but occasionally the pneumococcus or diphtheroid bacillus may be the infective organism. The disease may be specific in origin, being commonly the result of infection by the tubercle bacillus, less fre-

quently the *Treponema pallidum* or the ray fungus of actinomycosis.

PATHOLOGY

Pathologically an inflammatory process of the mediastinal areolar tissue is either acute or chronic, diffuse or localized, suppurative or non-suppurative. On this basis the following classification may be recognized.

Classification of Mediastinitis

I. Acute mediastinitis
  a. Acute non-suppurative — Localized
    Diffuse—Mediastinal cellulitis
  b. Acute suppurative — Localized—Mediastinal abscess
    Diffuse—Mediastinal phlegmon

II. Chronic mediastinitis
  a. Chronic nonspecific
  b. Tuberculous — Localized—Cold abscess
    Diffuse
  c. Syphilitic — Localized—Gumma
    Diffuse
  d. Actinomycosis.
  e. Hodgkin's Disease.

The importance of acute mediastinitis is largely dependent upon whether or not suppuration occurs. An acute mediastinal cellulitis is a frequent accompaniment of infections of the pleurae and lungs. However, the condition is not often recognized clinically. This is true for several reasons: first, the primary disease usually overshadows the mediastinal complication; secondly, the condition is usually unaccompanied by definite symptoms; finally, there is considerable difficulty of recognition by means of physical signs. The condition may frequently be detected in roentgenograms of the chest. Mediastinal cellulitis usually subsides without giving rise to serious consequences provided the primary disease responds to appropriate treatment (Case 1).

Of most importance is acute suppurative mediastinitis. This is a distinct clinical entity and one which is always of serious import. Fortunately, acute diffuse suppurative mediastinitis or mediastinal phlegmon is of rare occurrence. It almost invariably proves rapidly fatal. The localized form of acute suppurative mediastinitis or mediastinal abscess is more frequently encountered and fortunately is less often fatal. It is in the form of an abscess that mediastinitis is best known clinically. Such an abscess always demands attention regardless of the primary condition. It is this lesion which usually results from trauma. It should always be considered as a possible complication of a foreign body in the esophagus, trachea or bronchi. The site of a mediastinal abscess is largely dependent upon the location of the source of infection. When arising from lymph nodes the localization is dependent upon the particular group of nodes involved, as pointed out by Lerche.[22] While there is often but a single abscess, multiple lesions may occur.

Chronic mediastinitis is probably far more common than is generally recognized. Clinically it is difficult of detection even when suspected. It may occur as the end-result of an acute mediastinitis in consequence of which there is produced an extensive fibrosis. With the contraction of scar tissue much distortion of the various structures of the mediastinum occurs. It is surprising that this does not more frequently give rise to more serious disturbances in function. As the result of compression of the trachea and bronchi, dyspnea and cough may occur; involvement of the venous channels produces distention of the peripheral vessels of the neck and chest and distortion of the esophagus may produce disturbances in swallowing.

Chronic mediastinitis is a frequent sequel of acute pericarditis. This results in extensive adhesions between the pericardium, the pleura and the diaphragm, giving rise to the so-called chronic mediastino-pericarditis. This condition, while uncommon, is nevertheless a distinct clinical entity and its recognition is important, since remarkable relief can be given in some cases by the operation of cardiolysis.[2,35,36] The disease is often accompanied by a pericardial and pleural effusion and ascites. Van Deen[37] in 1846 was probably

the first to report this condition under the name of pseudocirrhosis of the liver. Hutinel[13] in 1895 described the same condition as a hepatic cirrhosis of cardiac origin. Pick[30] in 1896 gave a more complete description and the condition is frequently referred to as Pick's disease. Kelly[15] wrote a lengthy monograph in 1903 on multiple serositis which includes mediastino-pericarditis. Smith and Liggett[35,36] have recently reviewed the subject summarizing 107 cases treated by cardiolysis with a comprehensive follow-up of 26. Etiologically these authors found 46 per cent of cases to be rheumatic and 29 per cent tuberculous in origin. Syphilis was thought to be responsible in a few cases. Some writers mention typhoid fever, measles, scarlet fever and malaria, and it seems quite probable that the condition may follow a simple acute mediastinitis. Often the etiological factor is quite obscure.

Pathologically the condition is characterized by extensive adhesions between the pericardium and the mediastinal structures which tend to fix the heart to the sternum and costal cartilages in front, the diaphragm below and the spine posteriorly. Adhesions of rheumatic origin are likely to be more marked intrapericardially, while those due to tuberculosis are more in evidence extrapericardially. When the adhesions involve mainly the left ventricle,[35,36] the disturbance is most felt in the pulmonary circulation, manifested by dyspnea, asthmatic symptoms and pulmonary edema; while with involvement of the right ventricle or right auricle or with mechanical obstruction of the inferior vena cava, there is venous stasis with the development of a cirrhosis of the liver. This latter group constitutes Pick's syndrome or pericarditic pseudocirrhosis. Either type may be associated with a chronic multiple or polyserositis.

The most common cause of chronic mediastinitis is tuberculosis. In its localized form it gives rise to a chronic or cold abscess. This is, in the majority of instances, secondary to tuberculous caries of the thoracic vertebrae although it may occur from disease of the sternum, costal cartilages or mediastinal lymph nodes. This type of abscess frequently becomes calcified. The diffuse tuberculous mediastinitis is a frequent accompaniment of pulmonary tuberculosis. Clinically it is usually of secondary importance to the pulmonary disease and for this reason is often overlooked. Occasionally, however, the mediastinal involvement dominates the clinical picture, under which circumstances the condition becomes a more or less distinct clinical entity. Pathologically its effect on the mediastinum is the same as is found in chronic mediastinitis of nonspecific origin. Mention has already been made of the frequency with which tuberculosis is of etiological importance in chronic mediastino-pericarditis.

Syphilis of the mediastinum is considered by most writers as ranking next to tuberculosis as a cause of chronic mediastinitis.[6,13,21,23,32] It can occur as a localized or diffuse form. Pathological investigations show that syphilitic lesions of the mediastinum are usually not equally distributed. The sclerogummatous lesion predominates and according to Lian and Baron,[23] Harris[10] and Osler,[27] it is found most frequently about the superior vena cava. Blankenhorn[4] believes that obstructive types of chronic mediastinitis which resemble bronchial asthma are cases due to syphilis of the large vessels, usually the aorta and occasionally the superior vena cava. Cases of involvement around the inferior vena cava have been reported (Hutinel,[13] Schünemann[34]). A diffuse fibrosis throughout the mediastinal tissues may also occur without predominance in any one portion.

Mediastinitis due to infection from actinomycosis is a rare condition but a definite clinical entity. The face and neck are the usual primary sites but the disease may also occur in the lungs. Involvement of the mediastinum is always secondary. The portal of entry of the actinomycotic mycelia is probably either through a tooth,

a tonsil or the air or food passages, as was originally thought by Bollinger,[5] who described the condition in 1877. From the neck the process spreads to the superior and posterior mediastinum. The disease seldom occurs in the anterior portion. When it does there is usually an involvement of the entire mediastinum, although van den Wildenberg[38] reports one case in which the anterior mediastinum alone was affected.

In discussing Hodgkin's disease the question naturally arises as to whether or not this condition can be properly considered a form of mediastinitis. It has been classified in this manner by Blankenhorn[4] and Knox.[17] For some time there has been a controversy as to whether or not this disease is inflammatory or neoplastic in nature or a combination of the two. To those who believe it to be of inflammatory origin, the mediastinal forms of the disease would assume the aspects of a mediastinitis. The variety of clinical manifestations which this disease may present is also responsible for the confusion regarding its true classification. In many instances the condition is ushered in as an acute infection, and when localized to the mediastinum the resemblance to a true mediastinitis is indeed striking. When it is considered that pathologically there is produced an intense fibrosis in the connective tissue surrounding the involved glands and that this fibrosis may become rather diffuse and widespread, there seems ample justification for at least discussing this disease in connection with mediastinitis. Finally, the roentgen appearance of mediastinal Hodgkin's disease may so closely simulate a localized or a diffuse mediastinitis that differentiation by means of the roentgen examination alone is impossible. For these various reasons we have seen fit to include Hodgkin's disease in the above classification of mediastinitis.

SYMPTOMATOLOGY AND PHYSICAL EXAMINATION

The symptoms and physical signs of mediastinitis do not differ essentially from those encountered in other forms of mediastinal disease. While they may be quite numerous and variable, there is at times a surprising lack of complaint on the part of the patient. For the most part, the symptoms and physical signs are due to involvement of the various structures contained within the mediastinum and when one considers the multiplicity of these, it is not difficult to appreciate the complexity of the clinical picture that may be presented. Rose[33] has rather thoroughly catalogued the symptoms and physical signs that may at times occur from pressure within the mediastinum. We shall here consider only a few of the more outstanding of these.

In every case of mediastinitis one must dissociate those symptoms due to the primary disease from those truly of mediastinal origin. The cardinal symptoms of diseases of the mediastinum are cough, pain and dyspnea. These will vary considerably with the nature, location and the extent of the disease. Pain is usually substernal or interscapular in location. It may at times be referred to the shoulder. The cough is usually rather harassing, nonproductive and characteristically paroxysmal in type. Dyspnea is one of the outstanding symptoms and is rarely absent. The mechanism by which this occurs is not always clear. It may be purely mechanical in nature from pressure upon the trachea, bronchi or lungs. It may be nervous or circulatory in origin. Stridor is a frequent accompaniment of dyspnea. Orthopnea or tachypnea should suggest the possibility of a mediastinal lesion. Less frequently encountered symptoms are hoarseness or aphonia from involvement of the recurrent laryngeal nerve. Dysphagia from compression of the esophagus may be the symptom which directs the patient's attention to his condition. When the phrenic nerve is implicated, hiccough may be a very annoying symptom.

In mediastinitis the symptomatology is, in a large measure, dependent upon the rapidity of onset of the disease. In the acute variety, evidences of infection will be quite

prominent. Chills, fever, sweating and general malaise will be outstanding features. Pain, cough and dyspnea are more marked than in chronic mediastinitis. The pain may be sharp and lancinating. In mediastinal abscess it is throbbing in character and intensified by coughing or on exertion. In chronic mediastinitis evidences of infection are usually lacking. The symptoms frequently are quite mild and at times entirely absent. Pain, which is less constant and less severe, is usually dull and boring in character. The cough often possesses the brassy quality so frequently described in aneurysm of the aortic arch. It is in the chronic variety that hoarseness, aphonia and dysphagia are usually encountered. Giddiness on stooping may be a prominent symptom.

It is surprising the extent to which a mediastinitis may progress before producing any evidence that can be detected on physical examination. One of the most constant findings is an increase to percussion in the width of the substernal or interscapular dullness. In acute mediastinitis this is usually the only physical sign that can be elicited. However, in these cases fever of a hectic type, leucocytosis and the septic appearance of the patient are quite helpful in recognizing the inflammatory nature of the disease. According to Blankenhorn[4] an important sign in acute mediastinal cellulitis is a slow pulse rate which is uninfluenced by exercise or posture, but is released under atropine.

In chronic mediastinitis, congestion or cyanosis of the face or neck may occur from pressure upon the superior vena cava. Dilatation of the superficial veins or edema in the same areas may be an outstanding feature. When the vena azygos major is involved the dilatation of the veins or edema is to be noted over the right chest. Evidences of pericardial, pleural or peritoneal effusions are common. Various abnormalities of cardiovascular origin may be elicited such as cardiac arrhythmias and pulsus paradoxus.

ROENTGEN EXAMINATION

The roentgen examination affords the best means of detecting a mediastinitis. The roentgenologic diagnosis, however, offers considerable difficulty for several reasons. In the first place, it is entirely possible for a mediastinitis to be present without sufficiently altering the appearance of the mediastinal shadow as to permit its recognition. Secondly, the roentgen manifestations of all forms of mediastinal disease are much the same, so that differential diagnosis becomes a difficult problem. In spite of these facts, the roentgen examination of the chest affords an excellent adjunct to the usual clinical procedures employed. A close correlation between the clinical and roentgenologic findings becomes necessary before definite conclusions can be reached.

A widening of the mediastinal shadow usually indicates the presence of some pathological process. One must first determine that this appearance is not due to a widening of the arch of the aorta or undue prominence of the great vessels. This distinction is not always as simple as it would appear to be. The roentgenoscopic observation, in which the aortic pulsations can be carefully studied, is of material aid in this respect. The localized bulging of the mediastinum commonly seen as the result of mediastinal tumors does not often occur in mediastinitis. Exception to this is occasionally seen in the purely localized forms of mediastinitis, as, for example, in a cold abscess of tuberculous origin. As a rule, the mediastinum shows a more or less generalized increase in width which is usually bilateral. The contour of the mediastinum is, for the most part, fairly regular and does not exhibit the nodularity so commonly associated with enlargements of the tracheobronchial lymph nodes. The above characteristics are not found exclusively in mediastinitis and, while helpful, cannot be relied upon solely for diagnostic purposes.

The history of the condition must guide one to the proper interpretation of the

abnormal appearance of the mediastinal shadow. In acute mediastinitis the clinical manifestation of acute onset, pyrexia and leucocytosis, will be found helpful. The etiology may be quite evident, such as the presence of pneumonia, trauma to the mediastinum, foreign body in the trachea or esophagus (Case I), a retropharyngeal abscess (Case IV), an infectious focus in the abdomen (Case II) or a surgical operation which has invaded the mediastinum. Under such circumstances a generalized widening of the mediastinal shadow is quite suggestive of an acute diffuse mediastinitis. It is extremely helpful if one is fortunate to have had a roentgenogram of the chest prior to the onset of the mediastinal complication. By comparison the abnormal appearance of the mediastinal shadow is more readily detected and its significance more fully appreciated. It is only by this means that slight alterations of the mediastinum can be recognized.

Here a word of warning must be given. Patients with acute mediastinitis are usually quite ill, not necessarily from the mediastinal complication but from the primary disease. Roentgen examinations of such cases must often be made with the patients in bed and, at times, under conditions that are not very favorable for good technical results. Under such circumstances the normal mediastinal shadow may appear quite altered. One of the chief reasons for this is the short target-film distance usually employed in bedside examinations, approximately 30 inches as compared with the usual 48 to 72 inches used in routine chest exposures. This factor tends to increase the size of all shadows and will cause the mediastinum to appear unusually wide. Other factors enter into this consideration, such as the fact that bedside films are usually anteroposterior rather than posteroanterior projections. The patient's position is seldom as satisfactory. As a rule, the diaphragms are elevated and a full inspiration is not usually possible. These various factors tend to widen and distort the mediastinal shadow and must always be taken into consideration, especially if comparison is being made with roentgenograms taken by the usual chest technique.

In our own work all bedside examinations are done in the radiological department, the patient being brought to the department in bed. Every effort is made to examine patients in the erect posture. This can be done quite satisfactorily if the patient is not too ill to be transferred from bed to a litter. The litter is placed alongside of the stereoscopic plate changer and the patient is supported in the erect posture. Stereoscopic posteroanterior films are made using routine chest technique, with the exception that the patient is in a sitting rather than a standing position. Patients must be extremely ill not to be able to withstand such an examination. The results are so far superior to the usual examination made in bed that the additional effort on the part of the patient is well repaid. Consent must be had from the clinician in charge to move the patient from bed and to place him in the erect posture.

The most readily recognized form of mediastinitis from the roentgenologic point of view is the acute localized suppurative variety, the so-called mediastinal abscess (Cases III, IV, V). It is often possible in such abscesses to demonstrate a fluid level (Fig. 5, B). This simplifies the diagnostic difficulties considerably. Such an abscess may present itself as a localized bulging of the mediastinal shadow, but in most instances there is in addition a generalized increase in size denoting a diffuse inflammatory reaction throughout the mediastinum. The contour of the shadow is, as a rule, fairly smooth and regular. An associated swelling of the soft tissues of the neck is a common accompaniment, not only of the acute suppurative but of the acute non-suppurative variety of mediastinitis. This swelling can best be demonstrated in the lateral view of the neck, where there will be seen a definite increase in the width of the retrotracheal and possibly the retropharyngeal space as

well. This finding should be of aid in recognizing the inflammatory nature of the mediastinal disease. Likewise in all infections involving the lower portion of the neck an examination of the mediastinum is in order because of the tendency of inflammatory reactions to spread into this portion of the chest. The diffuse suppurative mediastinitis or mediastinal phlegmon cannot be differentiated roentgenologically from the non-suppurative variety. This distinction must be made from the clinical manifestations which indicate an extreme degree of sepsis. The condition is usually rapidly fatal.

The various forms of chronic diffuse mediastinitis present much the same roentgenologic appearance. Here again the characteristic feature is the increased width of the mediastinal shadow, although this need not necessarily be present. The mediastinal contour is usually somewhat irregular and indistinct, because in addition to the associated pleural reaction there is also some involvement of the subpleural pulmonary tissue. There is seldom a localized tumefaction such as is encountered in the neoplastic diseases. There may be noted a definite increase in the density of the mediastinal shadow. This finding is difficult to evaluate, however, because of the marked variations in density to be noted in what is regarded as the normal mediastinum. Effects upon various structures commonly occur and are very helpful in directing attention to the mediastinum. This is particularly true as regards the trachea which may be deviated from its normal position by contraction of fibrous tissue. Distortion of the main bronchi may also occur. In studying these structures it is best not to rely on ordinary chest roentgenograms alone, as the increased density due to the mediastinitis may in part obscure them and give rise to appearances of distortion, which are found not to exist when films are made with the Potter-Bucky diaphragm. In cases of mediastinitis the shadow of the arch of the aorta is obscured and the aortic knob is often not discernible. The direct communication of the mediastinum with the lung by way of the hilus frequently causes the hilar shadows to be increased in size and density and they are often found to be more homogeneous than normal. There may also be a definite increase in the prominence of the pulmonary trunk shadows and linear markings as the result of stasis produced in the pulmonary veins by pressure from fibrous tissue at the root of the lung. Various irregularities in the cardiac silhouette may result from adhesions between the pericardium and pleura or pericardium and diaphragm. In the lateral view there may be noted considerable obscuration or even complete obliteration of the preaortic or retrocardiac spaces.

A study of the esophagus is indicated in all conditions in which the mediastinum is suspected of being the site of the disorder. An abnormality in the esophagus may be the only roentgenologic evidence of disease and this is often true even in the absence of esophageal symptoms (Case v). The esophagus may show deviation from its normal course. It may exhibit areas of constriction with dilatation above causing difficulty in swallowing. Traction diverticula of the esophagus not infrequently result from a localized mediastinitis. It is important, therefore, that visualization of the esophagus by means of an opaque medium be done in every suspected case of mediastinitis.

Of the utmost importance in the study of chronic mediastinitis is the roentgenoscopic observation. Aside from the findings already mentioned, there will be noted a more or less complete fixation of the heart during the two phases of respiration. At times an actual upward tug on the heart may be seen on deep inspiration (Case vi). If the patient is observed in the lateral position the heart will be seen to follow the sternum upward and forward during deep inspiration and there is no increase in size of the preaortic space as normally occurs. Holmes[11] attaches considerable importance to such observations, stating that

they do not occur in conditions other than a chronic mediastinitis. One source of error, however, must be guarded against in this connection. In individuals whose respiration is of the costal variety, there will be noted on deep inspiration a fixation of the diaphragm and a definite upward movement of the heart which can be seen both in the anteroposterior and lateral positions. This simulates very closely the phenomenon seen in chronic mediastinitis. In cases of chronic mediastino-pericarditis there may be noted, during suspended respiration, considerable traction upon the basal trunk shadows of the lung adjacent to the heart, the result of pleuro-pericardial adhesions. Furthermore, adhesions between the pericardium and the diaphragm can be detected by definite tugging of the diaphragm, especially the left dome, when observed during full inspiration. It should be remembered that a certain amount of pulsation of the diaphragm, synchronous with the heart beat, occurs normally. It is only when this phenomenon is exaggerated and out of proportion to the degree of cardiac pulsation that significance can be attached to it. In some cases of mediastino-pericarditis there may be noted a definite diminution in the force of the cardiac pulsations.

To study the degree of fixation of the mediastinum anteroposterior roentgenograms of the chest should be made with the patient lying first on the right side and then on the left. Normally there will be seen a considerable shift of the heart and mediastinum to the right with the patient lying on the right side. With the patient on the left side the shift to the left is considerably less. With fixation of the mediastinum as occurs in a chronic mediastinitis this lateral shift of the heart is considerably decreased.

As a part of the roentgen technique in suspected cases of mediastinitis there should be included roentgenograms made with the Potter-Bucky diaphragm. This may reveal primary or secondary lesions in the vertebrae or ribs such as a Pott's disease of the spine or an osteomyelitis of the ribs (Fig. 8, B). Reference has already been made to the more accurate study of the trachea and main bronchi by this method. Enlargements of the tracheobronchial glands are more readily demonstrated. The fluid level in an abscess may thus be revealed. For this purpose the films should be made in the erect posture.

While the above findings are more or less characteristic of a chronic diffuse mediastinitis, reliance must be placed upon associated clinical and roentgenological data to determine the specific nature of the pathological process. In the case of tuberculous mediastinitis (Case VII), there is usually, but not necessarily, an associated pulmonary lesion. The clinical manifestations are those of a chronic pulmonary tuberculosis. While the pulmonary lesion usually dominates the picture, both roentgenologically and clinically, there are cases in which the mediastinal involvement is out of all proportion to the pulmonary disease. Evidence of a mediastinitis in the presence of a tuberculous pulmonary lesion, regardless of its size and extent and whether or not it is healed or active, is strongly in favor of the mediastinal disease being also of tuberculous origin.

The finding of a localized form of tuberculous mediastinitis, namely, a cold abscess, is usually the result of a roentgen examination of the spine, since the signs and symptoms presented by the patient indicate the spine as the location of the pathological process. Such lesions seldom give rise to mediastinal symptoms. The roentgen appearance of this form of cold abscess is quite characteristic. In such cases there is usually seen an irregular mass of variable size occupying the posterior mediastinum, which is associated with a definite caries of the bodies of one or more vertebrae. Such abscesses show a marked tendency to undergo calcification and for this reason are readily detected roentgenologically. While this form of tuberculous mediastinitis may arise from a focus in a mediastinal gland or a lesion of

the sternum or costal cartilages, it is a much less frequent occurrence.

Chronic mediastinitis, the result of syphilis or actinomycosis, presents no characteristic roentgen appearance. In the case of the former the diagnosis is based largely upon the presence of a positive Wassermann reaction and the exclusion of other etiological factors. Other evidences of syphilis, such as a luetic aortitis, should suggest the possible luetic nature of the mediastinal disease. A gumma of the mediastinum may present the roentgen appearance of a neoplasm. Although luetic mediastinitis is relatively uncommon, a serological examination should be done in every case in which the etiology is obscure. A favorable response to antiluetic treatment is necessary to establish the diagnosis. Much the same problem is presented in the case of antinomycosis (Case VIII). Unless there are associated lesions about the mouth or neck, or a chronic sinus from the mediastinum in the discharge of which sulphur granules are detected, little thought is likely to be given to the possibility of actinomycosis, since the condition is so rarely encountered. The isolation of the ray fungus is, of course, essential to a positive diagnosis.

Involvement of the mediastinal glands in Hodgkin's disease is a common occurrence. In the typical case little difficulty in diagnosis is encountered roentgenologically since the characteristic enlargement of the cervical glands aids materially in recognizing the cause of the abnormal mediastinal shadow. The appearance of the mediastinum is by no means diagnostic and unless accompanied by other definite clinical manifestations of Hodgkin's disease the diagnosis cannot usually be made from the roentgen examination alone. It is not often that the condition will be confused with a true mediastinitis. In Hodgkin's disease there is usually a definite nodularity to the contour of the mediastinal shadow. As a rule, there is greater involvement of the hilar region than is seen in mediastinitis. In many instances, there is an apparent pulmonary infiltration extending outward from the hilus. We have not seen this occur in mediastinitis.

The greatest difficulty in diagnosis will be encountered in those atypical cases of Hodgkin's disease in which the clinical manifestations are those of an infectious process and in which the only demonstrable evidence of disease is in the mediastinum (Case IX). Blankenhorn states that Hodgkin's disease may occur as an acute mediastinitis. Under such conditions it cannot be differentiated from other forms of acute mediastinitis. However, at times the roentgen characteristics indicated above and the fact that a primary acute mediastinitis is relatively uncommon will favor the diagnosis of Hodgkin's disease. Furthermore, roentgen therapy may prove of diagnostic value, since the glandular enlargements of Hodgkin's disease are materially reduced in size by irradiation. This procedure would be of no aid in the mediastinitis of Hodgkin's disease which, according to Blankenhorn, does not respond. Likewise other forms of mediastinitis are without benefit from roentgen therapy (Case VII).

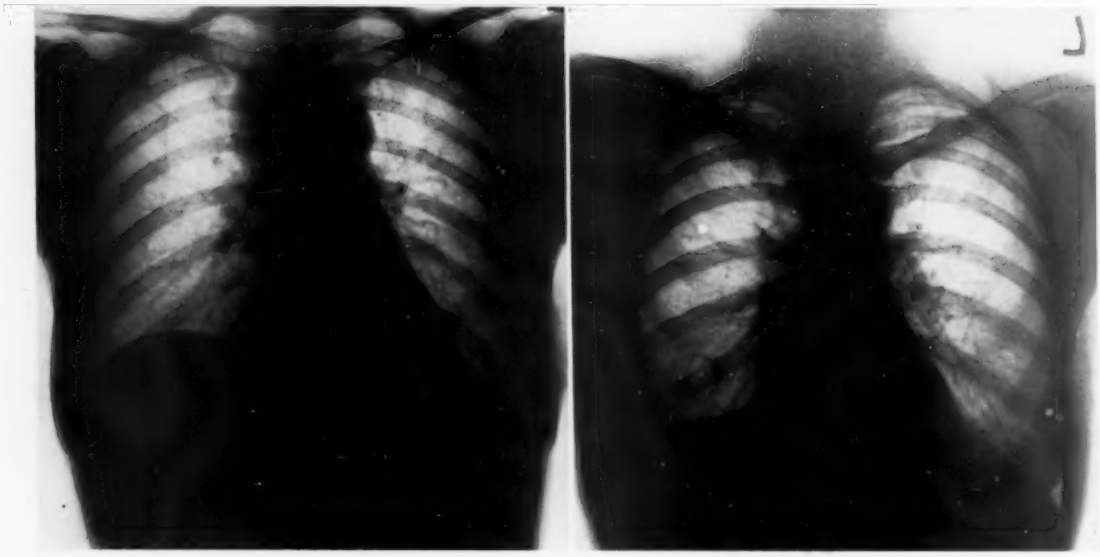
CASE REPORTS

A few selected case reports will serve to illustrate the various forms of mediastinitis that may be encountered.

Case I. M. E., white female, aged forty-five, admitted to the service of Dr. Gabriel Tucker, September 1, 1928, six hours after having swallowed a bone which lodged in her throat. A roentgen examination of the neck made on admission showed an opaque foreign body in the lower cervical esophagus. Esophagoscopy was promptly done and the piece of bone removed without the slightest difficulty. Eighteen hours after admission there was a sharp rise of temperature from normal to 101.5°F.

Roentgenograms of the chest of September 7, six days after admission, showed a definite widening of the superior mediastinal shadow especially to the right. Three days later this had increased in size (Fig. 3, A).

Under conservative treatment the patient's condition gradually improved and temperature returned to normal. A roentgenogram (Fig. 3,



A B

Fig. 3. Case I. A. Roentgenogram nine days after removal of piece of bone from esophagus showing a wide superior mediastinal shadow with smooth contour. B. Roentgenogram eight days later showing complete regression in the width of the mediastinal shadow. Interpretation was non-suppurative mediastinal cellulitis.

B) made seventeen days after admission shows complete regression of the mediastinal shadow. Patient discharged four days later, symptom-free.

Comment. This is a case of acute non-suppurative mediastinitis secondary to a foreign body in the cervical esophagus.

Case II. S. M., white male, aged forty-five, a patient of Drs. T. Grier Miller and E. L. Eliason, admitted to the University Hospital on July 6, 1931, complaining of rather severe pain in the right hypochondrium which radiated to the back and was made worse by deep breathing. This had developed gradually over a three day period following a strain when patient slipped.

Examination revealed heart sounds of poor quality and râles at the right base with distinct limitation of expansion. Temperature was 102°F., pulse 110, and the leucocyte count was 24,000. Gallbladder or pulmonary disease was suspected.

A roentgenogram made on admission (Fig. 4, A) revealed a high position of both domes of the diaphragm, the right more so than the left, which roentgenoscopically was also markedly restricted in motion. In addition there was an apparent pneumonic process in the right lower lobe. Roentgenologically two diagnoses were suggested: (1) an infective cholangitis with a resultant lung reaction; (2) beginning pneumonia of the right lower lobe. Another roentgenogram made two days later (Fig. 4, B) revealed a definite widening of the mediastinal shadow, especially to the right. This shadow presented a smooth, sharply demarcated border and remained unaltered with changes in position of the patient. Two days later a third roentgenogram (Fig. 4, C) showed a marked regression of the mediastinal shadow. There had been no operative interference and no aspiration of the chest. All roentgenograms were made in the same position.

Nine days after admission a cholecystogram was interpreted as indicative of a non-functioning gallbladder. The following day the patient was discharged free of symptoms.

There was an interim of eighteen months during which time the patient enjoyed good health. He was readmitted on February 8, 1933, after having had two attacks of pain referable to the gallbladder area. On admission a roentgen examination revealed a condition similar to that to be seen in Figure 4, B, but with more density at the right base, probably due to fluid. Again there was noted a marked increase in the width of the mediastinal shadow both to

the left and right. Operation the following day by Dr. E. L. Eliason revealed a perforated gallbladder and subdiaphragmatic abscess on the right side. The right chest was aspirated at the time of the operation and a number of times subsequently; 300–500 c.c. of clear, straw-colored fluid was removed each time without affecting the appearance of the mediastinal shadow, although the position of several of the aspirations was such as to enter the mediastinal portion of the pleural cavity.

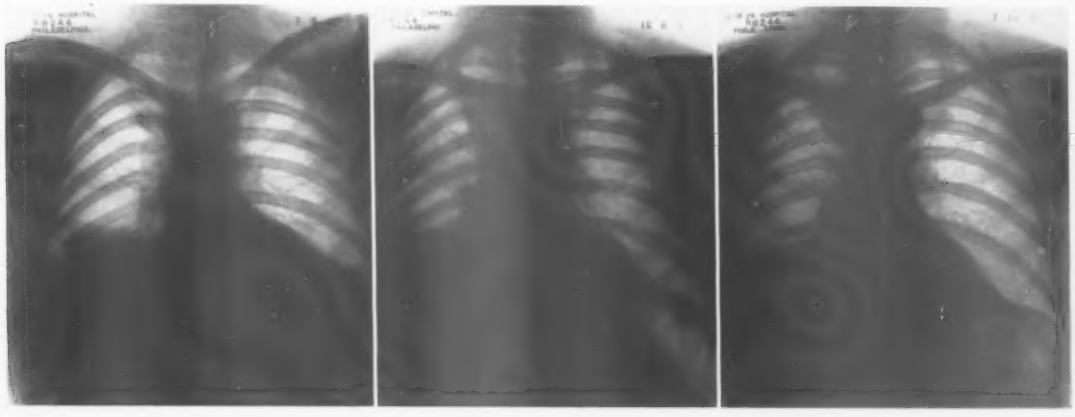
The patient made a slow but uneventful recovery. At the time of discharge on April 1, 1933, a roentgenogram again showed a regression of the mediastinal shadow similar to the appearance seen in Figure 4, c.

Comment. This is another case of acute non-suppurative mediastinitis or mediastinal cellulitis. The condition had to be differentiated from an effusion in the mediastinal portion of the pleural cavity by which it was, no doubt, complicated on the second admission. The rapidity with which the mediastinal changes occurred on the first admission was in favor of a diffuse inflammatory reaction in the mediastinum rather than an effusion. The infection apparently extended from the gallbladder region through the diaphragm by way of the lymphatics. This is a fairly common occurrence in cases of this kind.

Case III. J.B., white male, aged forty-one, patient of Dr. O. H. Perry Pepper, admitted on December 27, 1929, complaining of substernal pain and a sense of pressure within the chest. Symptoms had been present for about twenty years but had only become severe since 1927. A short time before admission the condition had become worse and necessitated seeking relief. The patient had had typhoid fever, scarlet fever, whooping cough, measles severely three times, and appendicitis in 1918. Physical examination was essentially negative.

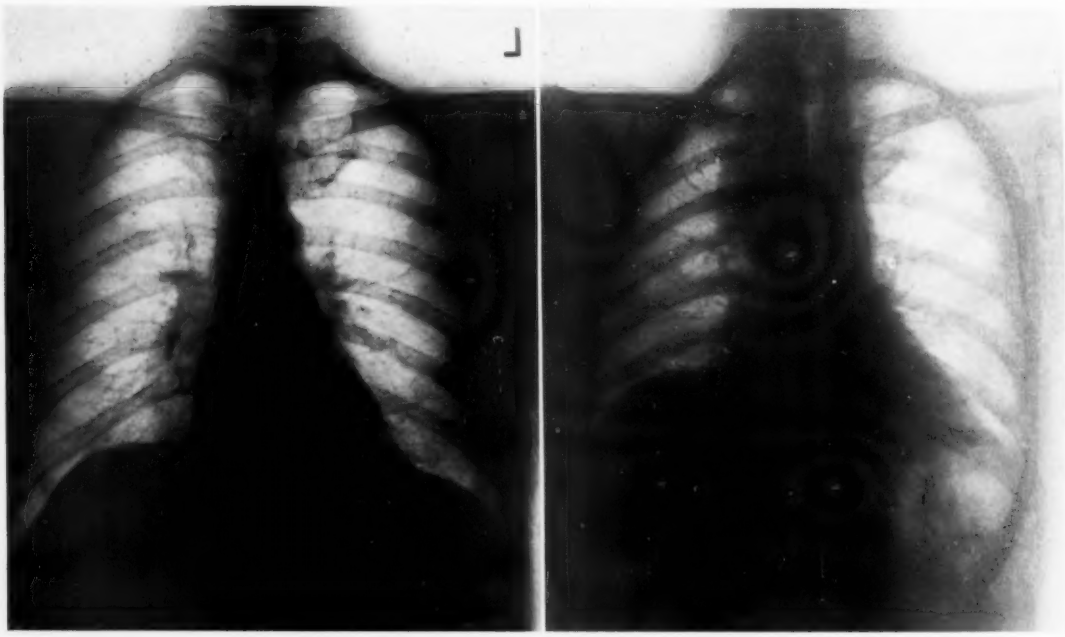
At the time of admission a roentgen examination of the neck, chest (Fig. 5, A) and swallowing function was negative except for the lodgment of a bismuth capsule a little above the point where the left bronchus crosses over th esophagus. The capsule could not be dislodged by drinking water, thus indicating a partial obstruction in this portion of the esophagus.

An esophagoscopic examination on admission showed a narrowing of the mid-thoracic esophagus without ulceration. This was the point at which the capsule had lodged. The impression was that a peri-esophageal inflammatory or



A B C

Fig. 4. Case II. A. Examination on admission shows both diaphragms elevated, the right more so than the left, and the right was markedly restricted when observed roentgenoscopically. There is an apparent pneumonic process in the right lower lobe. Diagnosis: infective cholangitis with a resultant lung reaction; beginning pneumonia right lower lobe. B. Examination two days later showing a definite widening of the mediastinal shadow with sharply demarcated borders, interpreted as an effusion in the mediastinal portion of the right pleural cavity. C. Examination two days after B, showing a marked diminution in the width of the mediastinal shadow. No operative procedure. Mediastinal cellulitis, secondary to a cholecystitis, considered the best explanation in view of the rapid clearing. All roentgenograms made in the erect postero-anterior position.



A B

FIG. 5. Case III. A. Normal appearance of mediastinal shadow on roentgenogram taken at the time of admission. B. Appearance of chest at the time of the second examination showing a marked increase in the mediastinal shadow and a definite fluid level indicative of a mediastinal abscess. The condition proved fatal and at autopsy there was found a diffuse mediastinal phlegmon.

neoplastic lesion was causing the narrowing. From the time of admission the symptoms became progressively worse. Some time later the patient suddenly went into a state of shock with elevation of temperature to 106°F., pulse 170 and respirations 40.

A second roentgen examination made several days later showed a marked change, consisting in a widening and increased density of the superior mediastinal shadow (Fig. 5, B). There was a definite fluid level present indicative of a mediastinal abscess. In the lateral view there was noted an anterior displacement of the trachea which localized the abscess in the posterior mediastinum. The case terminated fatally in a few days.

At autopsy a mediastinal phlegmon superimposed upon an abscess with marked fibrous walls was found in the posterior mediastinum a few centimeters above the bifurcation of the trachea. Infection had extended along every plane involving the pericardium and both pleurae, the right more than the left.

Comment. In this case there was a diffuse suppurative mediastinitis or mediastinal phlegmon, apparently the result of reactivation of a chronic abscess which was probably of twenty years' duration.

CASE IV. (Reported by W. K. Kistler.[16]) J. D., elderly white male, admitted to the service of Dr. Gabriel Tucker at the Graduate Hospital. Films were made by Dr. J. G. Cohen. A large retropharyngeal and retrotracheal abscess (Fig. 6, A) developed one week after the patient had attempted to pass a stomach tube to relieve an esophageal stenosis. After inserting a bronchoscope to relieve the patient's dyspnea, Dr. Tucker incised the abscess and evacuated about 16 ounces of pus and considerable foul smelling gas.

Roentgen examination of the chest (Fig. 7) revealed a widening of the superior mediastinal shadow with sharply demarcated borders. A lateral roentgenogram of the neck and chest after injection of bismuth paste into the retropharyngeal abscess showed that it had extended downward into the superior mediastinum (Fig. 6,B). There will be noted a definite anterior displacement of the esophagus and trachea. This was much more evident before the abscess was drained.

A B

Fig. 6. Case IV. A. Lateral roentgenogram of the neck disclosing a large retropharyngeal abscess with air and fluid level. B. Lateral view of the neck and chest after injection of bismuth paste into the retropharyngeal abscess reveals a direct extension of the abscess into the superior mediastinum. There is an anterior displacement of the esophagus and trachea.

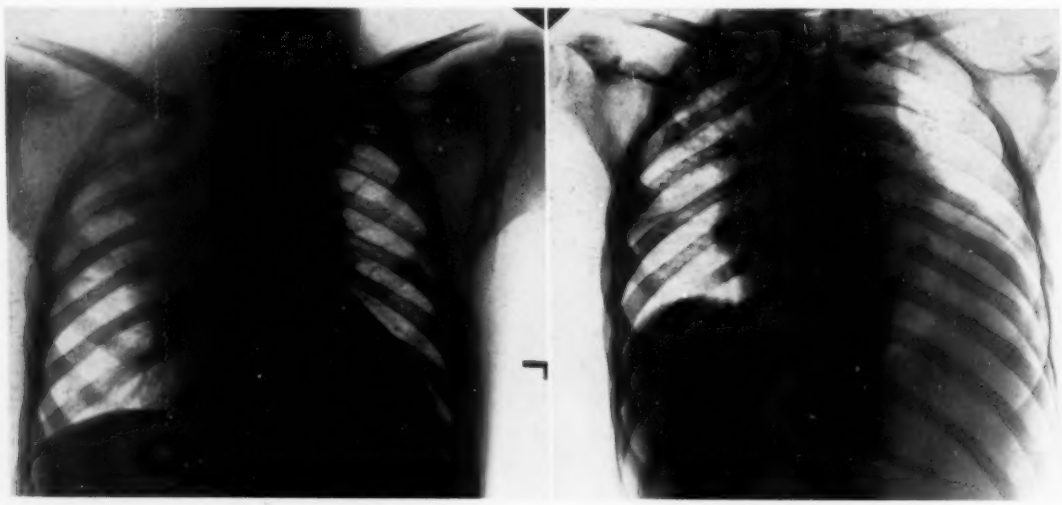
Comment. This variety of mediastinal abscess having its origin in the neck is fairly common. Incision of the abscess in the neck usually suffices to drain the mediastinal collection. A mediastinotomy does not, as a rule, have to be resorted to.

Case V. P. G., white male, aged seventeen, admitted to the service of Dr. Chevalier Jackson, Temple University Hospital, with the complaint of a productive cough, hemoptysis, loss of weight, weakness and dyspnea on exertion. The patient was well until September, 1932, when he states that he developed pleurisy. Two months later, November, 1932, he developed a painful swelling in the middle of his back which was subsequently opened and pus evacuated. On December 27, 1932, he was admitted to Mont Alto Sanatorium. While there he had a pulmonary hemorrhage.

Roentgenograms of the chest, which were kindly sent to us by Dr. R. H. McCutcheon of Mont Alto Sanatorium, presented the same appearance as was subsequently found at Temple University. A diagnosis of mediastinal abscess or new growth complicated by tuberculosis of the right lung was made. Roentgenograms (Fig. 8, A) made by Dr. W. E. Chamberlain showed a marked widening of the mediastinal shadow and a mottled appearance over the right upper chest. A film made with the Potter-Bucky diaphragm (Fig. 8, B) revealed definite evidence of osteomyelitis involving the posterior portion of several of the upper ribs on both sides.

Dr. Wayne Babcock subsequently resected a portion of three ribs on the left side posteriorly. Drainage was somewhat delayed, but was later

Fig. 7. Case IV. A widening and increased density of the superior mediastinal shadow as seen in the posteroanterior view.



A B

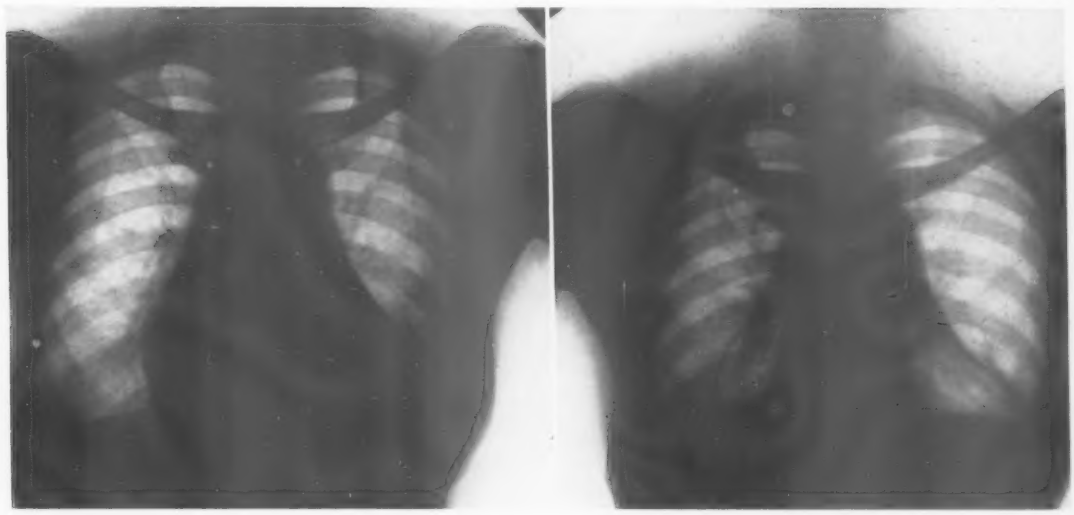
FIG. 8. Case V. A. There is widening of the superior mediastinal shadow and a mottled density over both apices, especially the right. Mediastinal abscess or new growth suspected. B. Roentgenogram made with the Potter-Bucky diaphragm revealed an osteomyelitis of the posterior portion of the upper ribs on both sides. Posterior mediastinotomy was done, draining a mediastinal abscess.

established, following which there was a drop in temperature. A study of the resected ribs showed definite evidence of an osteomyelitis.

Comment. As so frequently occurs, the etiology in this case is uncertain. This history of onset, hemoptysis and the roentgen appearance in the right upper chest is strongly suggestive of a tuberculous origin. A secondary infection apparently occurred in the mediastinum, which may have been superimposed upon a primary tuberculous mediastinitis. This case beautifully illustrates the manner in which an infection in the mediastinum may extend posteriorly around the bodies of the vertebrae and thus involve the tissues between the parietal pleura and ribs.

CASE VI. (Reported by Kornblum, Bellet and Ostrum.[19]) M. T., a colored female, aged thirty-eight, was admitted to the Philadelphia General Hospital on August 16, 1931, with a chief complaint of dyspnea. The symptoms started acutely two days before with chilliness, swelling of the face, neck, arms and breasts. The temperature was 101°F., pulse 110 and respirations 55 a minute. The patient had had previous admissions with somewhat similar symptoms. The onset of her illness dated back to July, 1929. She had had a roentgen examination of her chest made in March, 1931, which revealed some generalized enlargement of the cardiac silhouette and some widening of the superior mediastinal shadow. The lungs were negative. The cause of the enlargement of the heart was not recognized at the time. An enlarged lymph gland removed from the right side of the neck was reported as "chronic proliferative lymphadenitis; no evidence of tuberculosis." The physical examination revealed an enlargement of both breasts, especially the right. There were numerous distended veins over the right neck, chest and abdomen. The heart was enlarged to the left and there was evidence of aortic dilatation. A rough systolic murmur could be heard over the mitral area. Laboratory studies were negative. The symptoms and physical findings were regarded as evidence of mediastinal pressure and led to a clinical diagnosis of a luetic aortitis with aneurysm or mediastinal tumor.

A roentgen examination in August, 1931 (Fig. 9, A), revealed a marked enlargement of the cardiac silhouette and a widening of the superior mediastinum. Roentgenoscopically there was noted a complete absence of pulsation of the heart or great vessels. On deep inspiration, instead of the usual descent of the apex of the heart with the diaphragm, there was noted a slight but definite upward tug. The lungs were again negative. A roentgen



A B

Fig. 9. Case VI. A. Examination of the chest revealed considerable increase in size of the cardiac silhouette. On the basis of the roentgenoscopic observation, a diagnosis was made of "adhesive pericarditis," probably tuberculous. B. After the removal of fluid from the pericardial sac and the injection of air, this roentgenogram showing the hydropneumopericardium was obtained. Note the small size of the heart and the density about its base due to the presence of adhesions. Chronic tuberculous mediastino-pericarditis found at autopsy.

diagnosis was made of "adhesive pericarditis, probably tuberculous in nature." A total of 300 c.c. of blood-tinged fluid was withdrawn from the pericardial sac and 400 c.c. of air injected. A roentgenogram of the pneumopericardium (Fig. 9, B) revealed the heart to be very small with adhesions about the base.

The patient subsequently developed a bilateral pleural effusion, her condition became progressively worse and she died on September 24, 1931.

Autopsy revealed a chronic adhesive pericarditis. The lumen of the superior vena cava, where it entered the right auricle, was almost completely obliterated by the adhesions of the pericardium. The pulmonary artery and aorta were also somewhat constricted. Nothing of note was found in any of the other organs. Microscopic study of the pericardium revealed the tuberculous nature of the disease. Injection of the pericardial fluid into a guinea pig was positive for tuberculosis.

Comment. This is an example of a chronic mediastino-pericarditis of tuberculous origin. The constriction of the great vessels by mediastinal and pericardial adhesions was responsible for the symptoms and signs of mediastinal pressure.

Case VII. (Reported by Kornblum and Cooper.[18]) F. W., white male, aged fifty-seven. Patient complained of a chronic cough of eight months' duration which was uncontrollable, brassy in character and came on in paroxysms. He had lost 35 lb. since the onset of his disease. He had never had any pulmonary complaint before. Examination of the chest showed some increase to percussion of the supracardiac dullness, mainly to the right. The lungs were negative. There were a few palpable cervical glands. Repeated examinations of the sputum were negative for tubercle bacilli.

A roentgen examination (Fig. 10) revealed an old tuberculous lesion in the left apex and a definite widening of the superior mediastinal shadow to the right. The diagnosis was a probable primary neoplasm.

Under deep roentgen therapy the patient became definitely worse so that this form of treatment had to be discontinued. A biopsy done on one of the glands removed from the neck was reported as tuberculosis. The patient's condition became progressively worse and he died a cardiac death four months later.

Autopsy revealed an extensive tuberculous mediastinitis involving the pericardium, myocardium, peribronchial lymph nodes, the pleura and adjacent portion of the lung.

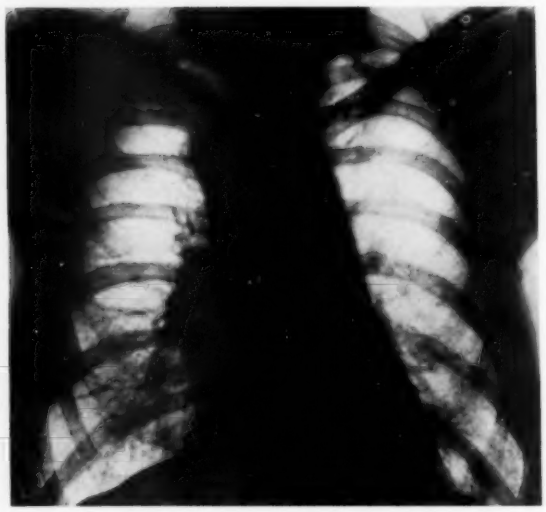


FIG. 10. Case VII. An old tuberculous lesion in the left apex with a widening of the superior mediastinal shadow to the right, interpreted as a primary neoplasm. Autopsy revealed a diffuse tuberculous mediastinitis.

Comment. The mediastinitis in this case was unquestionably secondary to either the pulmonary or lymph node involvement. Nevertheless, it was the predominant lesion clinically, roentgenologically and pathologically.

CASE VIII. (Reported by R. C. Logefeil.[24]) H. J., white boy, aged fourteen, admitted to Fairview Hospital, Minneapolis, Minnesota, February 3, 1929, complaining of shortness of breath, pain in the lower chest and severe cough. The patient had been well until nine months previously, when he had an attack of pleurisy in the left lower chest. After a free interval of three months there developed an irritative cough becoming intractable, severe precordial pain and marked dyspnea. The abdomen had become enlarged two weeks before admission. The patient had always lived on a farm and had had no previous serious illness.

Examination revealed an emaciated boy who was orthopneic, cyanotic and annoyed by a persistent, dry cough. There were numerous distended veins over the neck, chest, and abdomen. Several enlarged cervical nodes were present. There were signs of fluid at both bases. Mediastinal dullness was markedly increased in width. The liver was enlarged and tender. There was fever of a septic type. Blood counts showed erythrocytes 3,750,000; leucocytes 15,000 with 90 per cent polymorphonuclears.

The roentgen examination of the chest (Fig. 11) made on February 5, 1929, showed considerable enlargement of the heart, a wide mediastinal shadow with irregular borders and a small bilateral effusion.

From these clinical and laboratory data, the following diagnoses were made: (1) cervical and mediastinal adenopathy, probably a lymphosarcoma or Hodgkin's disease; (2) mediastinal pressure syndrome; (3) adhesive pericarditis with constriction of the inferior vena cava and resulting in passive congestion of the liver; (4) decompensating heart; (5) bilateral pleural effusion; (6) low grade bronchopneumonia.

An autopsy the entire mediastinum, pleura with adjacent lung, both layers of the pericardium and the great vessels to and from the heart were matted together in a mass composed of firm, grayish tissue containing pus pockets varying in diameter from a few millimeters to 2 centimeters. The superior vena cava was not obstructed, but the lumen of the inferior vena cava, near its opening into the right auricle, was reduced to a small diameter by fibrous tissue. There was a bilateral pleural effusion, ascites and a cardiac cirrhosis of the liver. The

FIG. 11. Case VIII. Roentgen examination showing greatly enlarged heart, wide mediastinal shadow with irregular borders and a bilateral pleural effusion, interpreted as a lymphosarcoma or Hodgkin's disease. Autopsy revealed actinomycotic infection of the entire mediastinum involving pleura and pericardium.

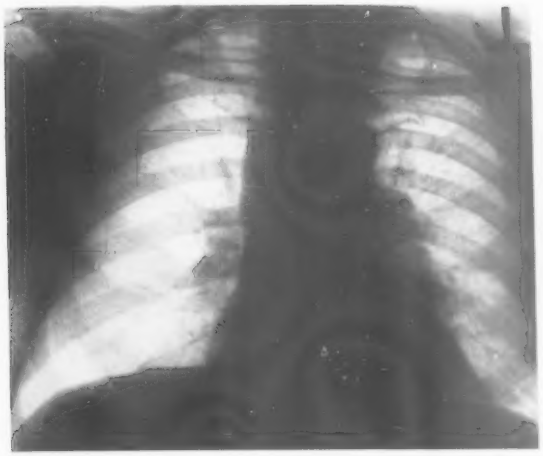


Fig. 12. Case IX. Roentgenogram showing prominent hilar shadows, especially the left, and increased lung markings on the left side, interpreted at first as a residual pathology from a pneumonia—abscess not excluded. Later interpretation was a mediastinal Hodgkin's disease or a primary bronchogenic carcinoma. Autopsy revealed mediastinal Hodgkin's disease with infiltration into the apex of the left lower lobe.

pus obtained from the abscesses contained numerous sulphur granules from which the ray fungus was identified, thus establishing the diagnosis of actinomycosis.

Comment. This case, which presents all the characteristics of Pick's syndrome, is one of actinomycotic mediastino-pericarditis.

Case IX. (Reported by D. A. Cooper.[7]) J. P., white Italian male, aged seventy-two, was admitted July 1, 1929, giving a history of fever, pain in the chest, dyspnea and hemoptysis. Patient was well until six months before admission when he began to have small hemoptyses. Three months later he was taken acutely ill and his physician made a diagnosis of "pleuropneumonia." The patient never completely recovered from this, fever and sweats being the outstanding symptoms. He subsequently developed a carbuncle on the back of the neck which was incised. He then caught a cold, at which time his physician suspected a collection of pus in the chest. He was then admitted to the University Hospital.

Examination revealed a small palpable node above the left clavicle. There was some increase in supracardiac dullness, more on the left. The blood count showed erythrocytes 1,300,000; leucocytes 7,900; hemoglobin 46 per cent, with neutrophils 87 per cent; lymphocytes 7 per cent, monocytes 4 per cent. The report of the roentgenogram of the chest (Fig. 12) was as follows: "Widening of the aortic arch, considerable prominence at both hilar shadows, particularly the left. The appearance on the left side suggests residual pathology from a pneumonia, but an abscess cannot be excluded; slight thickening of the interlobar pleura on the left, no evidence of effusion." On reviewing the films later, it was decided that in view of the physical findings and the blood count, the mass in the left hilus with widening of the mediastinum could better be accounted for by Hodgkin's disease or a primary bronchogenic carcinoma. The patient's condition became progressively worse. The temperature ranged between 99 and 104°F., pulse 90 to 120 and respirations 30 to 40. There was an increase in the size of the gland above the left clavicle with development of others in the neck and right axilla. Biopsy of one of these glands examined by Dr. Herbert Fox was reported as "Hodgkin's disease of the diffuse fibrocellular type." The patient died thirteen days after admission.

At autopsy on removing the left lung there was a mass in the hilus, which involved the lymph nodes and infiltrated the apex of the left lower lobe. A large portion of the mass was made up of fused lymph nodes. Microscopic sections showed a typical Hodgkin's disease of the fibrocellular type.

Comment. The history and clinical manifestations in this case were definitely those of an infectious process rather than the usual type of Hodgkin's disease. Along with the roentgen appearance, the case closely resembles one of mediastinitis. It is this type of Hodgkin's disease that has no doubt led to its inclusion by some writers in the classification of mediastinitis.

SUMMARY

Mediastinitis is a localized or diffuse inflammatory process involving the areolar tissue of the mediastinum. Although the roentgen examination affords the best means of detecting this condition, the differential diagnosis is largely dependent

upon a close correlation with the clinical data. For this reason it is essential that the roentgenologist possess definite knowledge regarding the anatomy of the mediastinum, the etiology, pathology and clinical manifestations of mediastinitis. These subjects are discussed and, in addition, a pathological classification of mediastinitis is given. The roentgen aspects of mediastinitis are fully described. A few selected cases illustrating the various forms of mediastinitis are reported.

We are greatly indebted to Dr. R. H. McCutcheon, Dr. W. E. Chamberlain, and Dr. R. C. Logefeil for the information sent us and wish to thank them for granting us permission to publish their cases. We also acknowledge our indebtedness to Dr. Gabriel Tucker, Dr. T. G. Miller, Dr. E. L. Eliason, Dr. O. H. Perry Pepper, and Dr. D. A. Cooper for their kindness in permitting us to report cases from their services.

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ROENTGEN DIAGNOSIS OF CARCINOMA AT THE CARDIA

By WILLIAM H. STEWART, M.D., *and* H. EARL ILLICK, M.D.
NEW YORK CITY

THE purpose of this presentation is to call attention to the relative frequency of the occurrence of cancer of the cardiac end of the stomach; to discuss the methods of making a roentgen examination of this region, and to consider some problems in the differential diagnosis with the hope that roentgenologists will be able to assist in the early recognition of such involvement.

Roentgen examination in the hands of experts has aided greatly in the early diagnosis of gastric malignancy. The main reasons for failure to recognize gastric cancer at an earlier stage is the physician's failure to suspect and search for the lesion until the clinical picture is so typical that the lesion is too far advanced for surgical aid. The location of the cancer may make detection difficult even when search is made and this applies especially to involvement of the upper pole of the stomach.

Pyloric cancer is most frequent, comprising about one-half of all cases of cancer of the stomach, and obstructive symptoms may be a prominent part of the early complaints. Cancer of the body of the stomach, composing about one-third of all cases, is generally undiagnosed until inoperable. Cancer of the cardia is seldom diagnosed or suspected unless dysphagia is present.

TECHNIQUE OF ROENTGEN EXAMINATION OF THE STOMACH

Many physicians, without analyzing the matter, seem to underestimate the difficulty of making a proper roentgen examination of the stomach, regarding the owner of roentgen equipment thereby qualified to interpret roentgenograms even to the extent of relying on his report concerning the presence or absence of cancerous involvement of the stomach. They do not appear to realize that the quality of the examination depends more on the worker than the machine. Such a mistake is to be regretted because ability to interpret pathological findings as manifested on roentgenograms requires a background of considerable medical knowledge and correlation of postmortem and surgical findings with roentgen shadows.

The roentgenoscopic and roentgenographic examination of the stomach requires a technique as exacting as any surgical procedure. A certain standardization is essential so that a lesion may not be overlooked but there is necessary variation whenever the pathological involvement is thereby better demonstrated.

Careful *preparation of the patient* is essential and most important of all is that the stomach be as nearly empty as possible when the examination is conducted. Usually roentgenoscopy is begun in the morning on a fasting stomach, orders having been left that the patient is not to eat or drink anything, not even water, before the examination is made. Cathartics or enemas are not permitted. Use of a duodenal tube for examination of a test meal or to drain the stomach is usually inadvisable immediately before roentgenoscopy.

A careful preliminary *roentgenoscopy of the chest* is made to rule out the presence of lesions above the diaphragm. Such lesions are found with surprising frequency and often account for the complaints of a case submitted for gastric examination. Pulmonary tuberculosis, pleural effusions, sometimes metastatic involvement, cardiac or aortic lesions may be found. The mediastinum is given special attention.

Examination of the esophagus is then begun by asking the patient to swallow a small amount of a mixture of zoolak and barium of creamy consistency. He is rotated into

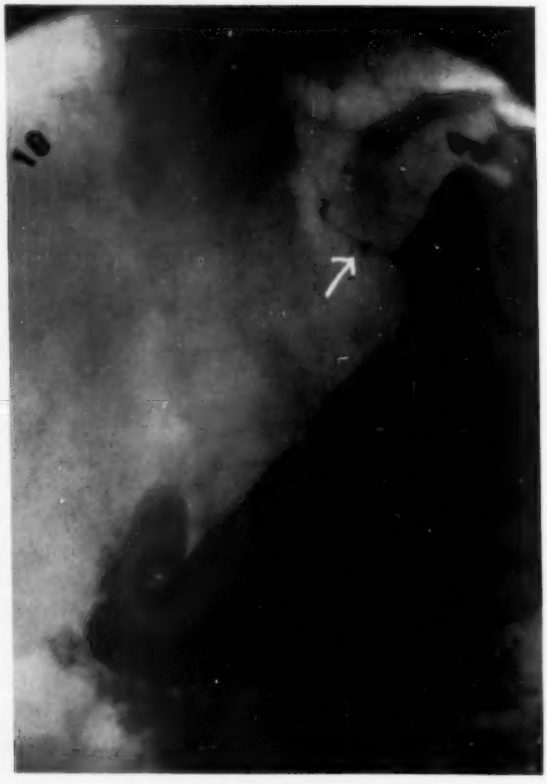

Fig. 1. Extensive malignant involvement of the cardiac stomach. The involvement is mostly on the posterior wall. Only slight dysphagia. Deformity and stiffening of the fundus. Narrowing and canalization of the cardia.

the right oblique position to best demonstrate the post-cardiac space. If there is any hesitation in the passage of this fluid barium, a heavy paste or at times a large capsule of barium is given. The paste is a thick mixture of acacia and bismuth. The capsule is oo size, has the diameter of a lead pencil and tests the esophageal lumen. By these means many lesions have been found when dysphagia is only slight and not a complaint of the patient at all and yet the degree of involvement may be marked (Figs. 1 and 8). The cardiac orifice and lower esophagus are watched with special care for any perceptible infiltration of the wall or contraction of the lumen.

The *examination of the stomach* is really begun before any barium is given, during the preliminary roentgenoscopy of the chest. The left diaphragm is watched during several excursions and the left upper quadrant is observed for any perceptible fluid level in the stomach. The gas bubble should be barely visible. If fluid is present, the study of the rugae will be impossible with any satisfaction. Occasionally a tumor mass may be visible through the gas bubble with the patient standing (Fig. 2).

The real examination of the stomach, and especially of the cardiac portion, begins after the first swallow of barium has entered the stomach. The patient is never permitted to take more than one swallow until certain observations can be made. This barium should almost immediately enter the lower pole of the stomach outlining the rugae of the midportion of the stomach and collecting in a pool in the lower stomach, leaving the cardiac end outlined by the gas bubble. By palpation

Fig. 2. Cancer mass visible through the gas bubble when the patient is standing. The inner angle of the Magenblase is characteristically deformed. Heart apex can be easily differentiated.

Fig. 3. Typical contraction and deformity of the rugae at the cardia. Fundus almost obliterated. Patient working as an engineer a year after the examination following roentgen therapy.

the entire stomach is outlined under the screen so that the pliability of the gastric wall can be tested and some idea obtained regarding any possible lesions of the anterior or posterior wall. The upper stomach is examined with special care for any abnormality in the appearance of the rugae. Tender points on palpation are localized, and masses and areas of resistance are searched for. Extrinsic masses or adhesions are sometimes more easily recognized with the stomach only partially filled.

Special *study of the gastric mucosa* is carried out at this time. The pattern of the gastric mucosa is more difficult to outline than that of the colon due to the fact that complete contraction of the stomach is never present; when the colon evacuates barium, traces are left which are sufficient to outline the contracted lumen of the bowel and the appearance is rather constant and characteristic. The empty stomach is a bag and the fundus has the largest lumen of all. In addition, some slight amount of gas and watery gastric secretion are present which interfere with obtaining clear detail of the mucosal folds. Direct palpation is difficult due to the costal arch. The best results in the study of the gastric mucosa are obtained with only a small quantity of barium, and films have the best detail which are made with short exposures; such films should be routinely made as part of every gastric examination. The relief pattern of the gastric rugae in the fundus conforms to a fairly regular standard, any marked variation or deviation from which requires careful investigation. The rugae form parallel folds producing a stripe-like appearance alternating with ribbons or strands of barium filling the valleys between the rugae, the whole pattern possessing regularity and uniformity. When organic disease is present there is marked irregularity and an abnormal bizarre pattern or else actual loss or absence of the relief markings; the parallel folds being replaced by irregular crisscrossing or radial striation, this deformity being constant (Fig. 3).

Various kinds of barium meals were used in an effort to find a material which would best "paint" the mucous membrane. Tragacanth, acacia, molasses, olive oil, and other substances, were tried in various combinations but none were found any more satisfactory than zoolak. This makes a very thick mixture which gives better results than paste or thin watery meals.

Compression technique was used to some extent although the high position of the cardiac end of the stomach beneath the costal arch makes external pressure difficult to apply and the results less satisfactory than in the study of the pyloric portion. A curved cassette was used as well as a Chaoul bag. A round rubber bladder ordinarily used for applying compression was inflated only slightly so that as the patient lay on it the bladder made a cushion one inch thick. This bladder was placed on top of the cassette with the patient prone; the compression obtained with this method was the most satisfactory.

After the necessary films are made the patient is given about a pint of the barium solution to fully distend the stomach and the usual roentgenoscopic and roentgenographic examination is made.

Fig. 4. Massive cancer of the cardia; entire fundic portion of the stomach is involved. Rugal irregularity, deformity, contraction of the fundus, narrowing and canalization at the cardia.

At some time between *two and four hours further studies* are made in all cases whose preliminary films are not entirely negative. It has been our experience that the study of the rugae is very satisfactory when the stomach is nearly empty of the barium meal or at this two to four hour examination. Many times spasm interferes with the first examination and is absent at this second examination permitting better filling to be obtained. Permanency of filling defects is also best tested by this procedure. A polygraph is sometimes used to obtain multiple views on one film of some certain area which is under suspicion.

The patient is again examined at six hours to record whether the stomach is completely empty and whether any diverticula or niches retain barium. If there is gastric retention, further examination may be necessary to record complete emptying of the stomach. Re-examination is often necessary and should be done more frequently if there is the least suspicion of any abnormality; there is no better method to avoid mistakes than repeating an examination.

Demonstration of early cancer of the posterior wall of the cardia is difficult and depends on careful roentgenoscopic and roentgenographic visualization of the rugae following a small meal; complete distention of the stomach covers up the lesion and it is missed. Occasional cases have a visible tumor mass through the Magenblase. Erect, supine, and even Trendelenburg position may be necessary to complete the study. It is essential to obtain a normal pattern of the rugae as well as normal filling of the distended stomach before reporting a case negative for cancerous involvement.

ROENTGEN PHYSIOLOGY OF DEGLUTITION

When a patient swallows a fluid barium meal, it passes downward through the esophagus at a rapid rate to the lower third where there is momentary hesitation before entering the upper end of the stomach. A column of barium about 3 or 4 inches high collects, and unless more is swallowed it disappears into the stomach in a few seconds. The lower esophagus is in constant, characteristic swaying motion as well as altered by peristalsis. The cardiac sphincter regulates the passage of the barium into the stomach, this discharge proceeding in a characteristic, spurt-like manner. If swallowing is constant, the stream of barium pours into the stomach but a single swallow is held back by the tone of the sphincter. The lower third of the esophagus is outlined to a larger lumen than it is above this portion due to the temporary retention of the barium above the sphincter. If conditions are unusually favorable, rugae may be visible in the lower esophagus. The length of the cardiac sphincter should be noted as well as the

general outline of the esophageal-gastric junction.

The ten roentgen signs of involvement of the cardiac end of the stomach by cancer:

1. Any dilatation of the lower esophagus.
2. Any abnormal retention of barium in the lower esophagus.
3. Barium passing through the esophageal orifice in a *continuous stream*.
4. Narrowed esophagus and unchanging canalization through tumor.
5. Frozen mass, the infiltration preventing the normal movements of the lower esophagus.
6. Mass visible in gas bubble; Magenblase deformed.
7. Mass visible after the first swallow of barium—distorted rugal pattern. Mass visible after distention of stomach by the full meal—contracted lumen.
8. Barium forking over the mass.
9. Gastric hypermotility.
10. Esophageal antiperistalsis.

These ten signs must be correlated with a clinical history of dysphagia, loss of weight and appetite, regurgitation of mucus, vomiting of blood or other positive findings.

1. The lower esophagus may be dilated to twice or three times the normal size of the lumen; the dilatation is never as great as with cardiospasm. Even slight increase in size of the lumen is of consequence and deserves study to ascertain the cause.
2. Retention of barium. If there is the slightest obstruction to fluids, a large capsule is given to test patency. If the patient finds that certain solid foods, such as toast, are especially difficult to swallow, this material if obtainable is used to test the patient's ability, being followed by barium solution to demonstrate the obstruction.
3. Normally the esophagus discharges its contents in a peculiar, characteristic, spurt-like manner which is altered when the sphincter is infiltrated by a malignancy so that the fluid empties in a continuous stream. There is no preliminary hesitation of the barium in the lower esophagus but immediate and continuous emptying.
4. The sphincter is lengthened and a narrow canal is seen passing through the tumor mass; the channel as a rule is irregular and has jagged margins (Fig. 4).
5. The mass of infiltration freezes the esophagus motionless so that the characteristic swaying and peristaltic movements of the wall are absent.
6. The gas bubble is normally a hemispherical black shadow above the fluid level; when the patient is standing, a mass may often be distinguished causing an irregular density to encroach upon the inner angle of this gas bubble (Fig. 2).
7. After a swallow of a barium meal, the

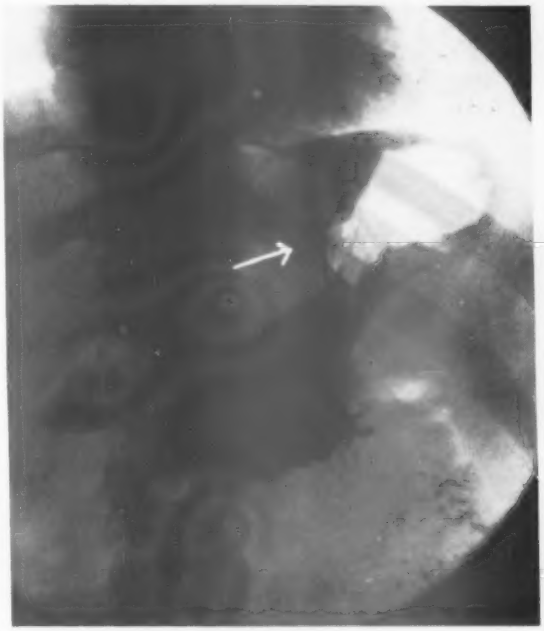

Fig. 5. Cancer at the cardia mostly on posterior wall. Rugal deformity and contraction of the fundus; narrowing and irregularity at the cardia.

Fig. 6. The oblique angle demonstrates involvement of the posterior wall by cancer. The usual prone observation failed to reveal any perceptible deformity. The only clinical complaint was vomiting of blood.

mucosal pattern of the gastric rugae in the cardiac portion of the stomach is altered; the normal regularity is lost; instead a bizarre, distorted, jumbled appearance may be demonstrated.

When the stomach is completely distended by a full meal, the lumen in the cardiac portion is narrowed and contracted; gastric cancer causes decreased size of the stomach (Fig. 5).

8. As barium trickles into the stomach, the stream often forks over the mass in the cardiac portion.
9. Malignant involvement of the cardiac stomach is accompanied by hypermotility of the meal so that the stomach empties early; the meal pours out through the pylorus at a much accelerated rate.
10. Antiperistalsis in the lower esophagus; as many as two or three waves are visible depending on the degree of obstruction.

The clinical history and findings are of more importance in the diagnosis of gastric lesions than in some other fields of roentgen endeavor. A hasty roentgen examination with no knowledge of the clinical possibilities will result in a large percentage of failures. Knowledge of a physical finding or certain clinical information may be the reason for the extra effort that makes a successful "confirmation."*

SYMPTOMS OF CANCER OF THE CARDIA

Cancer of the stomach may be present when a patient has few, if any, symptoms as well as after years of "stomach trouble," Anyone with "gas," dyspepsia, gastritis, or other abdominal discomfort lasting more than three weeks, who is middle aged or more should have a careful search made including roentgen examination in order to rule out malignancy.

Many patients with gastric cancer appear for diagnosis with the lesion too far advanced for surgical resection; one of the great fields for progress in medical diagnosis of the future is in the *earlier recognition* of cancer. The physician must suspect cancer more often and at an earlier date. He must insist that every laboratory procedure possible be used in studying the case. To wait for the advanced, typical picture of cancer is to wait too long. Before cancer of the stomach is diagnosed early, the physician must insist that roentgen examination be made as routinely as the urine examination and repeated as often as sputum examinations.

The symptoms of cancer of the cardiac end of the stomach may be very indefinite even up to the time of death. One case of our series had no other complaint than

* Since this article was prepared, Dr. George W. Holmes of the Massachusetts General Hospital, Boston, has called our attention to the fact that in many cases of malignant involvement of the cardia, the space between the diaphragm and fundus is increased in width.

vomiting of blood (Fig. 6); another only tarry stools for two weeks.

Dysphagia when present is of great value; it is found in more than half of the cases. The patient may not volunteer this information but answers affirmatively when directly questioned. When any difficulty in swallowing or substernal pain is complained of, cancer of the cardia should be borne in mind and excluded only after thorough examination.

Cancer of the cardia involving the esophageal sphincter secondarily or by direct extension is much easier to detect roentgenographically than involvement limited to the cardia, especially if only the posterior wall is affected (Fig. 7). Any obstruction to the passage of the barium is more easily recognized than mere deformity of rugae and of the partly filled fundus. It is in this type of lesion limited to the posterior wall at the cardia that cancerous involvement is missed until it is so extensive that the diagnosis is obvious.

About one-fourth of cases of gastric cancer have abdominal complaints for years; three-fourths of all cases have a short history. The most common history is slight loss of weight, fatigue, belching, nausea, anorexia, mild epigastric distress after eating, occasionally real pain, vomiting, achlorhydria, blood in the gastric contents, no dyspepsia previously and of middle age. Onset may be with hemorrhage or dysphagia.

Persistent blood in the gastric contents during treatment is an important finding making malignant involvement almost certain. Sippy used to suspect that every case of ulcer was malignant if there were persistently positive blood tests after two weeks' treatment.

More cases of early cancer of the stomach will be disgnosed when physicians refuse to make a diagnosis of chronic dyspepsia. Not to suspect cancer, not to look for cancer it to miss cancer. It is safer to consider every patient of middle age with gastric symptoms for more than one month as cancerous until proved otherwise.

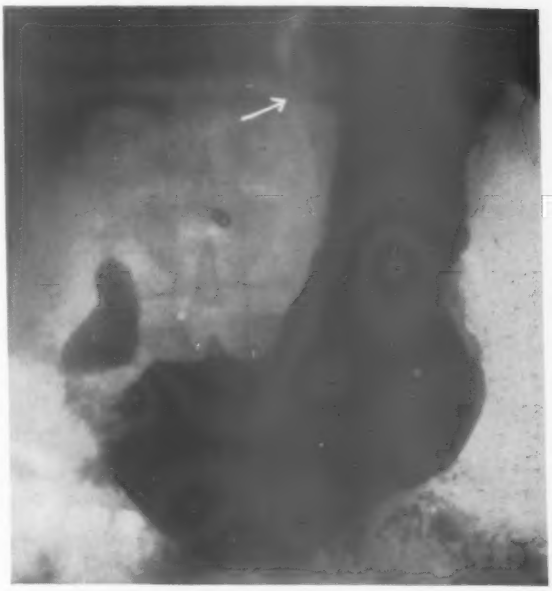

Fig. 7. Inoperable cancer of the posterior wall of the stomach involving the cardia. Filling defect is slight when stomach is distended with barium.

DIFFERENTIAL DIAGNOSIS

1. Cardiospasm. Spasm in any part of the intestinal tract is the most disturbing factor encountered and the most difficut to differentiate. Repeated examinations are often an aid as the permanency of the defective filling is thereby directly tested. Spasm may be persistent enough to give the same deformity in filling at several examinations and this is especially true of cardiospasm. To induce spasm, an irritant such as pepper may be given with the opaque material. The filling defect of cardiospasm occurs above the diaphragm and is typically cone-shaped or funnel-like with smooth margins. The dilatation may be extreme and even slight involvement shows greater dilatation than accompanies cancer. Fluid levels may be visible and splashing be demonstrated. The clinical history of duration of the complaints is longer. With cancer the mass is demonstrable; the filling defect has a ragged border; margins of the canal are rough; the dilatation is slight; barium passes through the canal in a continuous, trickling stream. History of dysphagia is shorter.

Fig. 8. Example of cancer involving the cardia of the stomach presenting typical roentgen manifestations of "finger-print" deformity, bizarre, distorted mucosal pattern and dilated lower esophagus without dysphagia or pain.

2. Diverticulum of the lower esophagus is rare; it is usually in the upper or middle third.

3. Varix causes notching of the edge of the lower esophageal outline and masses of varices sometimes produce characteristic filling defects of the lumen; the mucosal folds are deformed. There may be slight dilatation.

4. Lesions causing outside pressure such as metastases. Rarely metastatic involvement may form masses in close relation to the cardiac sphincter and cause dysphagia and other complaints simulating intrinsic disease. Roentgenographically differentiation is usually easy. The esophagus is displaced; there may be some obstruction but the characteristics of malignant involvement are missing (Fig. 9).

5. Hernia of the diaphragm. A part of the cardiac portion of the stomach invaginates into the chest through an enlarged esophageal hiatus and may produce dysphagia, although most of these cases give few, if any, symptoms and are incidental findings during roentgenoscopy. The hernia is best demonstrated when the patient strains while holding the breath during the time that the barium meal is in the stomach.

6. Ulcer of the cardiac stomach. Benign ulcer may be encountered high up on the lesser curvature or even in the lower esophagus. The mucosal folds show radial striation. The larger the crater, the more likely malignancy is present; also if the crater does not promptly and entirely and permanently disappear after medical treatment.

Fig. 9. Example of differential diagnosis in lesions involving the cardiac end of the stomach. The case had roentgen signs of malignant involvement including a visible mass through the gas bubble, narrowed, canalized cardiac area and esophageal dilatation with retention of fluids. At post mortem the appearance was found to be due to spasm resulting from an enlarged liver due to metastases. The left lobe caused esophageal and gastric pressure and also the mass visible through the gas bubble. The cardiac narrowing was due entirely to spasm. The primary cancer was in the splenic flexure of the colon.

Pneumoperitoneum is occasionally of value in differential diagnosis.

7. Bands of adhesions form smooth sharp constriction with a longer history than a malignancy No tumor visible.

Finally the sausage skin method as advocated by one of us (W. H. S.) may be used in the differential diagnosis where one desires to know the length of the canalization at the cardia.

Treatment. A few words concerning what may be done after the diagnosis is made may not be amiss. A great debt of gratitude is due the progressive thoracic surgeons who have undertaken to relieve patients suffering from this affliction. The mortality is high but the technique is improving; the surgical treatment is still the most hopeful.

In closing, we realize that nothing essentially new has been presented, our purpose being rather to call attention to the frequency of malignancy at the cardia and the means at our disposal for the early diagnosis of this lesion.

OSTEOPOIKILOSIS

REPORT OF AN UNUSUAL CASE

By BERNARD H. NICHOLS, M.D., *and* E. LEE SHIFLETT, M.D.
Cleveland Clinic
CLEVELAND, OHIO

OSTEOPOIKILOSIS assumes a definite position in that group of bone diseases of controversial etiology. Wilcox[9] made an extensive review of the literature in 1932 and collected 17 cases, to which group he added 2 of his own. Since his review, several additional articles have appeared on the subject. Osteopoikilosis occurs in both men and women. There is no definite age incidence, but the greatest number of reported cases have occurred in patients under forty years of age. The youngest patient recorded was ten years old, and the oldest, fifty-four.

FIG. 1. Assembled roentgenograms of the skeletal formation showing the distribution and characteristics of the lesions in a case of osteopoikilosis combined with multiple osteochondromas, and extensive irregular cortical thickening of the long bones.

The etiology has not been established although numerous theories have been advanced. Wilcox considered the disease hereditary, but stated: "It is of interest to speculate that osteopoikilosis may be associated with parathyroid disturbance." Wilcox observed osteopoikilosis in a father and son, but a daughter did not show evidence of the disease. Svab[6] also considered osteopoikilosis hereditary and in a recent article reported the condition in a father and his two sons. There was a familial history of diabetes which Svab thought might have aggravated the pre-existent condition. Voorhoeve[7] believed it to be hereditary and felt that the condition should be classed with the dyschondroplasias. Albers-Schönberg[1] reported the first case and called it a structural anomaly. Schmorl[4] described it as a congenital anlage. Ledoux-Lebard, Chabaneix and Dessane[2] thought that typhoid fever might have been an etiologic factor in their cases. Steenhuis[5] and Watchel[8] reported cases associated with tuberculosis which raised the question of the relation of this infection to the disease. Newcomet,[3] from the roentgenologic appearance, thought the areas of increased density to be exostoses which extended from the cortex into the bone substance rather than outward.

In recorded cases, osteopoikilosis has occurred without symptoms. The cases have been discovered accidentally while examinations for some other expected condition were being made, or while a systematic examination of family groups was being carried out (Wilcox[9] and Svab[6]) in an effort

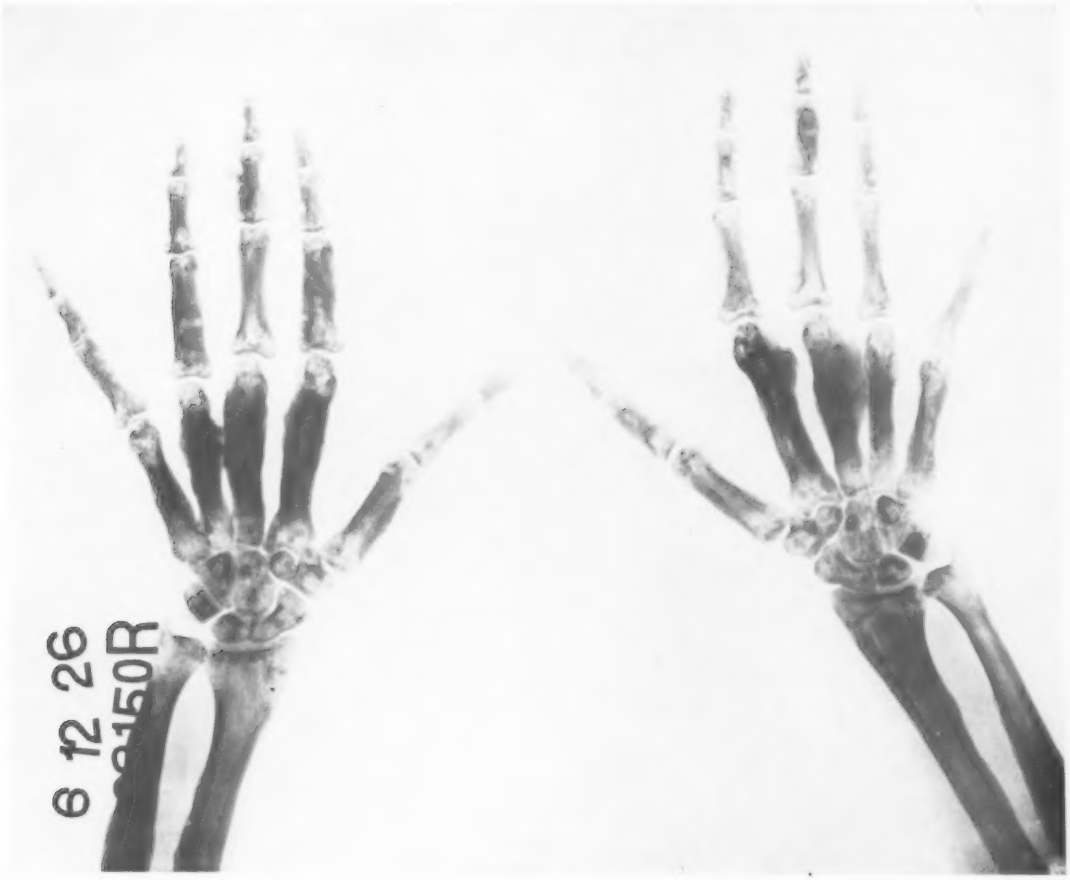

Fig. 2. Right and left hands, 1926. Characteristic spots of osteopoikilosis, cortical thickening and osteochondromatous formations. Compare with Figure 3.

to establish the hereditary nature of the disease.

Osteopoikilosis derives its name from the French word, *osteopoecilie*, a term used first by Leboux-Lebard, Chabaneix and Dessane[2] to describe the spotted appearance of the bones. Roentgenographically, the condition is characterized by multiple disseminated areas of increased density in the spongiosa of the bone. These vary in shape from oval to round, and in size from that of a pinhead to several centimeters. They occupy chiefly the metaphyses and epiphyses, less frequently the diaphyses of the long bones. Involvement of all bones except those of the skull have been reported.

Progress studies of the lesions tend to show that they are not progressive in extent or size, and show no change in calcium content. Newcomet[3] observed his patient over a period of four years and during this period there was no change in the lesions discernible roentgenographically. The case we are reporting showed no roentgenographic change in the areas of condensation over a period of seven years.

So far as we know, Schmorl has contributed the only histopathologic description of osteopoikilosis. Following is a brief abstract of the case report and a summary of his pathologic description:

The patient, a boy, aged fourteen, developed an acute osteomyelitis of the right tibia in October, 1926. The left tibia became similarly affected two weeks later. Contractures, ankylosis and destructive luxations resulted. Hemolytic streptococci, *Bacillus proteus* and diphtheria bacilli were demonstrated in the discharge from the sinuses. The boy died in 1929 from marasmus, amyloidosis, pyonephrosis and secondary anemia. Numerous roentgen examinations

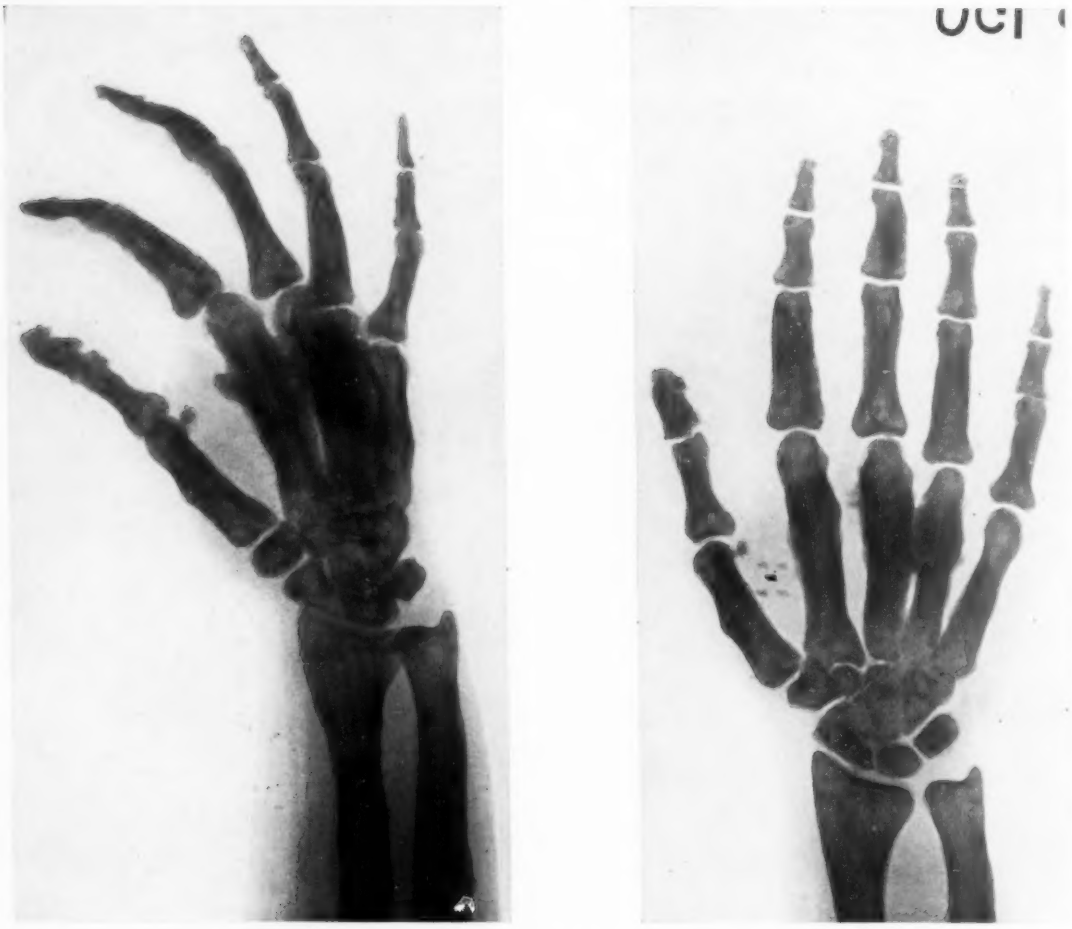

FIG. 3. Right hand, 1932. The areas of osteopoikilosis have not changed. The cortical thickening and osteochondromatous formations have increased in severity.

had demonstrated in all the skeletal bones except those of the skull and clavicle characteristic thick areas corresponding to the bone trabeculae and especially lying in the epiphyses. This was recognized as osteopoikilosis.

Pathologic examination showed that the areas which had shown as increased bone density on the roentgenograms varied from needle-head to pepper-grain size and were seldom larger. These were irregular and had somewhat jagged borders, and on the saw plane surface had homogeneous, grayish-white areas, appearing as small osteomas. They were partly round and partly oval. The areas of osteopoikilosis were compact and entered the spongiosa plates and trabeculae as small nodular formations. Almost never did these areas lie immediately in the bony terminal lamina of the epiphyses on which the joint cartilage is fastened, but were of a greater or lesser distance from it. Only in the surface of the intermediary cartilage were they at times situated on the latter. Those which lay on the spongiosa sections of the diaphysis were almost never in the axial plane of the spongiosa, but rather in the periphery where the spongiosa trabeculae attached to the bone rims, which at this point were not very thick.

The microscopic examination showed that the areas of increased density were formed by numerous juxtaposed trabeculae resembling those of the spongiosa more than of the cortex. This close arrangement gave the appearance of compact bone which was observed while studying the gross specimens. The merging of the trabeculae into the spongiosa was gradual and sharply defined borders were absent. The trabeculae were thin at times, at other times they formed tufts in which the thickness of the trabeculae varied. The thicker ones consisted of lamellous bone arranged mostly parallel to the long axis of the bone, but a few were obliquely arranged, while some were grouped chiefly in the periphery, concentrically around blood vessels, without a typical osteomatous formation.

The histologic study did not permit definite conclusions as to the genesis of the trabeculae. The author thought that they probably arose from the

fibrous portion of the bone marrow. It was not possible to determine whether the areas of osteopoikilosis increased in size after they had once formed. Schmorl stated that this would have to be determined by repeated roentgen examinations at regular intervals. He did not consider an endochondral origin probable as the areas of increased density were not connected with the endochondral zone of growth and areas of cartliage were not observed in any of the numerous areas described above. Rickets was not considered a probable etiologic factor. The conclusion was that osteopoikilosis is probably a congenital anlage.

The case herein reported is interesting from many points of view. The patient has been observed by one of us (Nichols) for seventeen years, and during this period she has had symptoms as described below. These symptoms led to a diagnosis of hypopituitarism and osteomata and numerous calcium deposits in bone (1916) and later of hypopituitarism (although roentgenograms of the skull showed a small, apparently normal, sella), hypothyroidism and osteopoikilosis (1926-1933). The onset of her illness dates to early adolescence and has continued with few variations to the present. Roentgenograms show multiple osteochondromata with at least one lesion resembling a cyst, multiple disseminated areas of bone density characteristic of osteopoikilosis and apparently a definite and marked proliferative periostitis of the long bones, and of the bones of the hands and feet, which at the present time is very severe.

We have not discovered in the literature a case of ostoepoikilosis similarly associated with endocrine dysfunction and these bone changes. Since osteopoikilosis remains a controversial subject, the case is recorded in detail.

CASE REPORT

The patient, a woman, now aged thirty-five, was first observed in 1916 when she was eighteen years old. She sought treatment because of headaches and pains in the feet and legs. The only significant fact in the family history was that all members, the father, mother, one brother and one sister were overweight. The patient had had scarlet fever, typhoid fever and diphtheria. In 1915, she had had two attacks of pleurisy, each of which lasted two weeks. As a child she had suffered frequently from earache. She had suffered considerably since the age of thirteen from headaches and had worn glasses for four months without relief. She had had occasional burning on urination, and the mother stated that the patient had passed blood in the urine during infancy, but none since that time. Her birth was normal, although, according to her history, she weighed only one and one-half pounds, but apparently she developed normally during childhood except that she was small for her age. She had never had any convulsions but had suffered one fainting spell during menstruation in the seventeenth year. She attended school until she was

FIG. 4. Forearm, 1926. Large osteochondroma of the ulna and cortical thickening. Compare with Figure 5.

thirteen years old but had been compelled to stop while in the fourth grade because of her physical condition. She stated that she was never considered very bright. There had been no idiosyncrasy of diet but the patient drank very little water. Her average weight varied from 99 to 100 pounds.

The menarche occurred at the age of seventeen and she had menstruated only six times during the first year, the periods being very irregular, at intervals of one to six months. The flow was not excessive but was accompanied by severe fatigue and the patient stated that she was "all used up" at the end of the period. Nervousness and weakness followed each menstrual period, and she complained also of hot flashes, dysmenorrhea, and a fainting spell on one occasion. The usual feeling of good health returned one week after cessation of the flow. A constant leucorrhea had been present since the onset of menstruation and had become quite marked.

Before seeking treatment she had been able to live a normal life. As a child, she was vigorous and had always enjoyed strenuous exercise and competitive games. However, she was al-

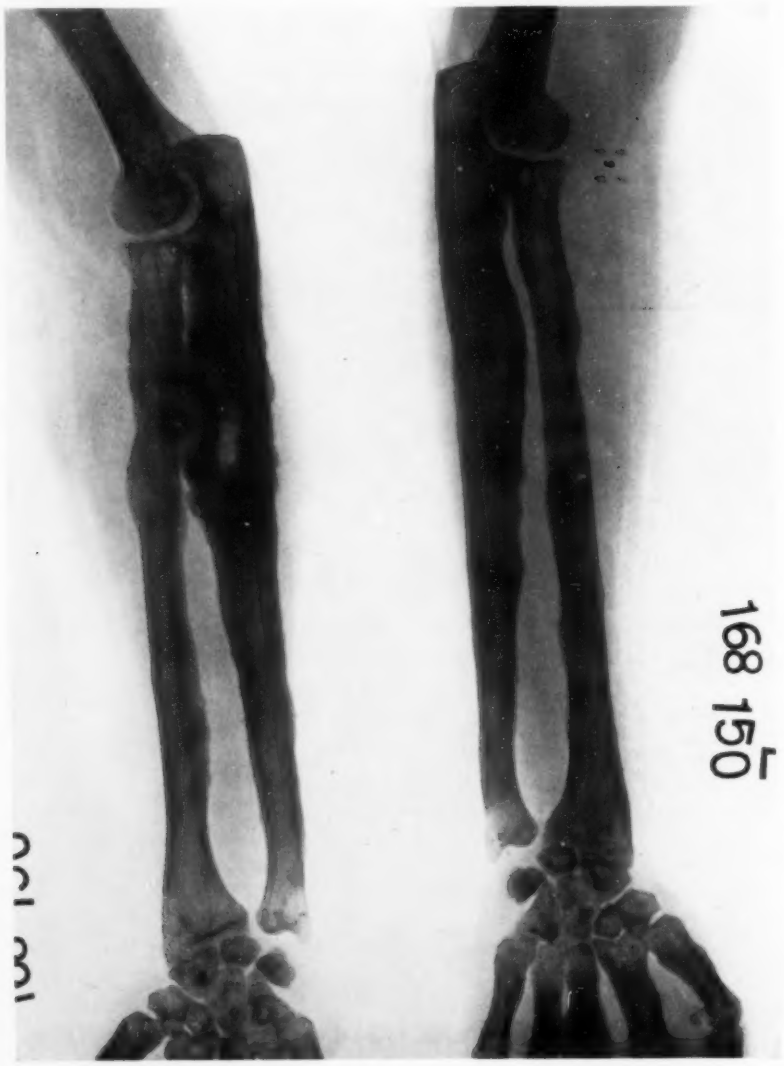

FIG. 5. Right and left forearms, 1932. The size of the osteochondroma and the cortical thickening have definitely increased. Left forearm shows changes similar to those in the right. Osteopoikilosis well demonstrated in the carpals and metaphyses.

ways rather small for her age which caused her to seek the company of girls much younger than herself.

When she was thirteen years old she began to have pains in her feet and legs. A tender, painful lump developed over the right tibia; the pain was especially severe with slight trauma. The right thumb became swollen, tender and painful. Then the left foot was similarly affected. She was fitted with arch supports by a layman for supposedly fallen arches. These increased her pain so much that she wore them only once. Next the middle finger on the left hand became persistently painful and felt

Fig. 6. Right foot, 1926. Typical spotted appearance of the bones of the feet and ankle. Compare with Figure 7.

Fig. 7. Right foot, 1932. Osteopoikilosis, osteochondromas and marked cortical thickening.

as though it were fractured. These abnormalities forced her to stop school. She also suffered from severe generalized headaches and a burning sensation in the eyes. Glasses gave no relief. Pains developed in the chest, side and feet, which seemed worse during inclement weather, and walking became painful. She suffered from nervous insomnia and frequently played solitary games during the night. The appetite was only fair. She had frequently been told that nothing was wrong with her. Special shoes, diathermy to the spine, and the fitting of glasses had been tried without any relief.

Physical examination at the age of eighteen showed that the patient was underdeveloped, though well nourished. The skin was moist, elastic and free from discoloration and pigmentation except for numerous freckles. The mucous membranes were normal. The hair was blond and was thin over the frontal regions. There were no cranial exostoses, but there was marked tenderness over the entire skull. The lobes of the ears were small but in keeping with the small facial features and skull. The eyes were normal. The chin and nasal bridge were prominent and the latter was of the Roman type. The teeth were erratically arranged, the pharynx and tonsils were slightly injected and the tongue was coated. The neck was rather short; the thyroid was palpable and the thorax was short, broad and deep. The patient was so

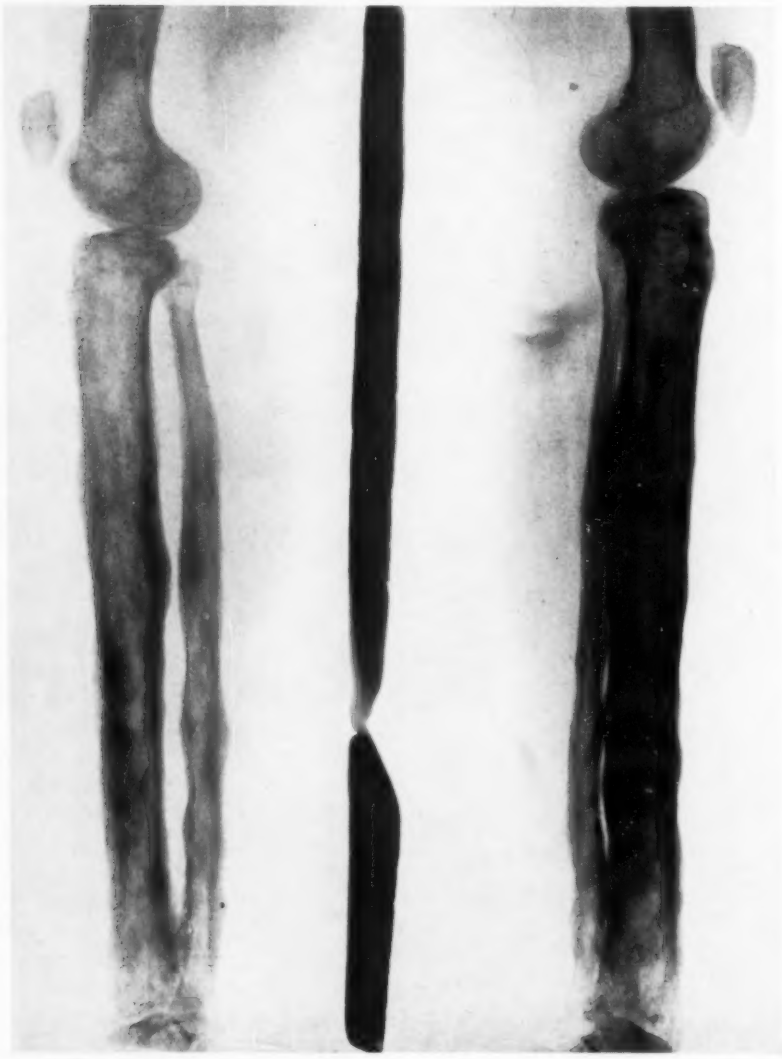

FIG. 8. Right leg, 1926. Marked cortical thickening and periosteal proliferation with characteristic spotted areas of osteopoikilosis in ends of the bones. Compare with Figure 9.

sensitive over the entire chest and abdomen that percussion and palpation could not be done satisfactorily. The heart was normal and the pulse rate was 90 per minute; the blood pressure was not recorded. The genitalia were not examined.

There was marked tenderness over the extremities. The right thumb showed marked thickening of the distal phalanx, presenting a clubbed appearance. The middle finger on the left hand showed a condition similar to that of the right hand, and in addition the metacarpals and all phalanges were involved. These were very painful to pressure but there was no local heat. Over the anterior surface of the left tibia and just below the knee there was a distinct painful bony thickening. On the left foot, the great toe was separated from the second toe by painful exostoses on the metatarsal. When walking, the patient kept the right foot turned at a right angle to the left foot. Reflexes were normal. Measurements showed a general decrease of length, breadth and circumference of various parts of the body.

Laboratory examinations showed the following: 5,120,000 erythrocytes; 11,000 white cells; hemoglobin, 75 to 80 per cent; polymorphonuclears, 63 per cent; small lymphocytes, 14 per cent; large lymphocytes, 22 per cent; transitionals, 0.5 per cent; eosinophils, 0.5 per cent;

Fig. 9. Right leg, 1932. Shows the definite increase in the cortical thickening and periosteal proliferation with no apparent change in the spotted areas in the ends of the long bones.

slight increase in central pallor, no nucleated red cells, no polychromatophils, no basophils, no stippling, no anisocytosis or poikilocytosis. The urine examination showed nothing abnormal.

The roentgen examination showed that the pelvis, femora, bones of the feet, tibia, wrist and hands had a very ragged appearance and numerous denser areas (osteopoikilosis) were apparent in the bones. The sella turcica was small.

The clinical diagnosis (1916) was multiple osteomata and hypopituitarism. The patient was given a pituitary preparation the nature of which was not recorded. She improved, became much brighter, more active and the generalized tenderness over the body decreased. She was discharged from the hospital on the twenty-second day. She did not return for observation and she was not seen again until June, 1926, when she told the following story.

The aching, tenderness and swelling in the joints had persisted throughout the ten-year interval without any definite change. She had considerable difficulty in walking and still complained of insomnia. Her weight had increased to 142 pounds. This rapid increase from 100 to 142 pounds had occurred between 1923 and 1926, when the patient was aged twenty-five to twenty-eight. She complained of a lump on

FIG. 10. Left knee. Characteristic spotted areas in the ends of the femur, tibia and fibula, and the patella. There is marked cortical thickening of the long bones. The two processes appear separate and distinct.

the right forearm and stiffness in the feet. Frontal headaches were almost continuous and glasses did not afford relief. She suffered from frequent colds. All the teeth had been extracted in the interim since her previous visit without relief. She suffered from dyspnea and had edema of the feet and ankles in the evening. Her appetite was fair, but constipation was marked. She had nocturia (three to four times) with the passage of a small quantity of urine. Her menstrual periods had become regular at the age of twenty-one; they occurred at monthly intervals with a flow lasting four days.

Physical examination (1926) disclosed many changes since 1916. She appeared to be oddly developed, was very obese, with heavy fat pads over the hips and back, and huge breasts. Her height was 4 feet, 7 inches; her weight, 142 pounds. The temperature and pulse were normal. Blood pressure was 130 systolic and 90 diastolic.

The head was small but well proportioned. The eyes were normal to inspection and the visual fields were normal. The pupils were equal and reacted to light and accommodation. The mouth was edentulous; the tonsils were infected and the thyroid was not palpable. The breasts were abnormally large. The chest, heart and abdomen were normal. She did not complain of generalized tenderness on palpation, as she had done previously. The external genitalia and the uterus were normal.

There was an overgrowth involving chiefly the ends of the bones of the hands and feet which did not involve the joints. The medical consultant made the following note: "The patient is very short, has a high-pitched voice and has the appearance of a young girl. The hands are very small and tapering. The feet are small and she wears a number 13 shoe. The head is small but apparently normal otherwise. The eyes are normal; the thyroid is not palpable. The chest is short and thick. The breasts are unduly large but contain no masses. There is a well-marked exostosis on the right forearm. The legs and arms are short and there is some thickening of the bones of the feet."

The laboratory findings were as follows: the urine was alkaline in reaction with a specific gravity of 1.007, a very slight trace of albumin, six to eight pus cells per high power field, a

FIG. 11. Pelvis, 1926. Characteristic areas of osteopoikilosis involving all the pelvic bones except the sacrum. Compare with Figure 12.

moderate number of epithelial cells and no sugar. The blood findings were 4,500,000 erythrocytes; 8,3000 leucocytes; hemoglobin, 85 per cent; polymorphonuclear neutrophils, 70 per cent; polymorphonuclear eosinophils, 2 per cent and lymphocytes, 28 per cent. The fasting blood sugar was 73 mg.; the urea, 19 mg.; uric acid, 1.6 mg.; chlorides, 575 mg.; there was no blood acetone. The glucose tolerance test revealed a definite prediabetic curve as follows: fasting blood sugar, 73 mg.; one-half hour later after the administration of 100 grams of sugar, 200 mg.; one hour later, 196 mg.; two hours later, 159 mg.; three hours later, 116 mg.; four hours, 71 mg. Sugar was present in the urine in the one and two hour specimens, the total output of sugar in the urine being 1.45 grams. The total fluid intake during the tolerance test was 850 c.c. and the total output of urine was 827 c.c. This is an unexpected result in a patient presenting the clinical signs of hypopituitarism, since there usually is an increased sugar tolerance in such cases. The basal metabolic rate was minus 7 per cent.

Roentgenographic studies showed evidence of extensive bone hypertrophy in the hands, forearms, head of the scapula, feet, tibiae and fibulae, femora and pelvis. The ribs, spine and skull were normal. There was a large cyst, probably an osteochondromatous formation, on the anterior aspect of the upper end of the right ulna. In addition there were numerous disseminated areas of increased bone density, varying greatly in size, and occupying chiefly

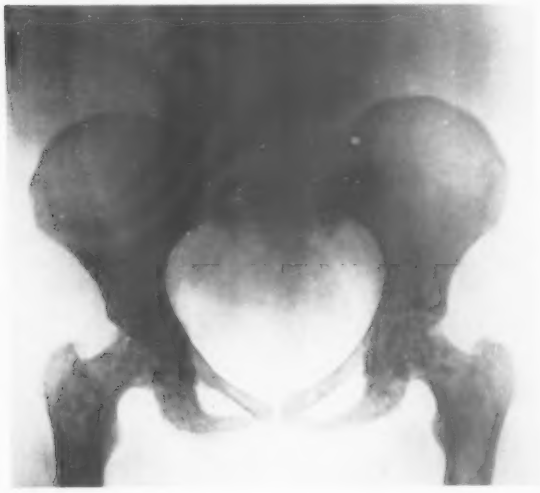

Fig. 12. Pelvis, 1932. No change in areas of osteopoikilosis since the examination in 1926.

Fig. 13. Skull shows no evidence of the lesions observed in the other bones.

the metaphyses and diaphyses of the long bones and all the bones of the hands and feet. The individual bones involved were the bones of the hands and feet, the scapula, patella, pelvis, clavicle and all the long bones. The bone hypertrophy consisted of osteomatous outgrowths and cortical thickening and was situated chiefly in the long bones, the metacarpals and metatarsals. The cortex was also roughened and in places it was impossible to differentiate cortex from the medullary canal. There apparently was a definite proliferative periostitis. The cortical thickening was most pronounced along the shafts of the long bones. At places along the tibiae and fibulae there apparently had occurred bony union through means of the exostoses or periosteal proliferations, meeting and merging into each other. Regardless of the extensive involvement of the shafts and diaphyseal ends the joint surfaces were left unaffected. The skull showed no abnormality except that the sella turcica was smaller than the average.

Roentgenographic comparison of the same bones made in 1930 and 1932 showed no change from the findings in 1926. The films taken in 1916 are not available for comparison but reasoning from the description of these roentgenograms there has been no appreciable change except for development of additional exostoses and periosteal proliferations.

The clinical impression in 1926 was that the patient had hypothyroidism and hypopituitarism. She was given thyroid extract, whole

pituitary gland, and general medical treatment. She was observed over a period of ten months. She continued to complain of body pains, constipation, frequency, and burning on urination, swelling of the hands, headaches, nervousness, insomnia and soreness over the joints. She would frequently report relief of one or more of the group of symptoms but on the next admission these had returned. During this period her weight decreased to 136 pounds. On one occasion the menstrual flow was profuse with the passage of blood clots. However, aside from the temporary and inconstant relief from one or more of the symptoms, the glandular therapy was without notable effect.

In December, 1932, phosphatase, blood calcium and blood phosphorus determinations were done with the following results: phosphatase, 4.38 mg. per 100 c.c.; blood calcium 10.29 mg. per 100 c.c.; phosphorus, 3.64 mg. per 100 c.c. The calcium and phosphorus are within normal limits. The phosphatase is definitely increased and indicates a definite generalized destructive process. The calcium balance was not determined. Another blood calcium determination was noted in January, 1933, as 9.7 mg. per 100 c.c.

Since March, 1927, the patient has paid occasional visits to the Clinic, and has also been under the care of her local physician, but her condition has remained practically unchanged, so far as we are able to determine.

DISCUSSION

It is impossible to make a definite statement regarding the type and extent of pituitary involvement, or as to the time of onset of the endocrine hypofunction in this case, but clinically, the patient is suffering from hypopituitarism. It is not our purpose to discuss endocrine disorders but rather to confine the discussion to osteopoikilosis.

Many authors have come to the conclusion that osteopoikilosis is essentially a structural anomaly, basically hereditary, in which there is a disturbance in the architecture of the bone, particularly in the cancellous portion. Schmorl's histopathologic study is not entirely conclusive, but indicates that the condition represents a structural anomaly not of enchondral origin. Inflammation and trauma have been practically discarded as etiologic factors in the light of accumulating knowledge and additional case reports.

From our observations, we believe that the lesions of osteopoikilosis are within the spongiosa of the bone and not exostoses originating in the cortex, and that the lesions are probably formed early in life and do not show progression either in number or size. Newcomet's[3] observations confirm the latter assumption. The spotted areas did not change over a period of seven years in the case we have described. We have no reason to infer that the exostoses and the periosteal proliferation are a result of extensions of the lesions described as osteopoikilosis. We cannot establish a connection between the two processes. It would appear that they are of separate origin and that the periostitis and exostoses have been progressive, while the areas within the spongiosa have been stationary. However, we cannot state definitely that the various lesions of the bones are not due to the same underlying cause.

Since only bones formed in membrane have not been reported as involved, it would seem logical to infer that osteopoikilosis, in some way, is related to enchondral bone formation, and that it results from an abnormal functional relationship between the osteoblastic and osteoclastic activity of cells during the growth period, but the histopathologic study made by Schmorl does not support this hypothesis. The inference of endochondral relationship also is supported by the fact that the diaphyses, metaphyses and epiphyses are involved, indicating that the process is associated with the growth period and continues until the epiphyses are united. This statement would of course be true only if the observations are correct that there is no progressive change in the lesions. This can be established only after further observation and study of a larger series of cases, particularly during the growth period. That the changes occur early in life and even in utero must be admitted if we ac-

cept the statement of Heilbron, who, while discussing Steenhuis' paper,[5] stated that he had observed identical bone changes in a fetus four months old. Keyser, during the same discussion, stated that he had observed osteopoikilosis or spotted bones in a child a few days old. To our knowledge these cases have not been recorded more fully in the literature.

We do not wish to add another theory as to the etiologic nature of osteopoikilosis. We merely report this case for whatever value it may have in definitely establishing the nature of the condition. In view of the theory of Ledoux-Lebord, Chabaneix and Dessane that typhoid fever might be an etiologic factor, it is interesting to note that the patient here described had had typhoid fever. We believe there is no similar case in the literature. The question of the probable influence of endocrine dysfunction as an etiologic factor is raised.

Certainly, osteopoikilosis still remains in the stage of case reports. The collected data are too few to justify definite conclusions concerning spotted bones. All cases should be recorded in detail as they are observed with the hope that the accumulated reports ultimately will establish the true nature and the cause of the condition.

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TECHNICAL CONSIDERATIONS IN ARTERIOGRAPHY OF THE EXTREMITIES WITH THOROTRAST*

By J. ROSS VEAL, B.S., M.D.,

and

ELIZABETH M. McFETRIDGE, M.A.

NEW ORLEANS, LOUISIANA

WHILE opaque media have been employed for many years in the roentgen diagnosis of arterial disease of the extremities, until the introduction of stabilized thorium dioxide none of them was entirely satisfactory. The visualization of the vascular supply presented little difficulty, but the first agents used, chiefly sodium iodide and various iodized oils, not only increased the local pathology but were actually, in some instances at least, inimical to life. The experimental and clinical report of Pearse and Warren in 1931 on the use of monoiodo-methane sulphonate for this purpose was exceedingly promising, but, so far as we can discover, no further work has been done with this agent.

Thorium dioxide (stabilized), which was first used by Oka of Japan in 1929 and by Radt of Germany in 1930, has given brilliant results in hepatosplenography and has been widely employed by many observers, including Tripoli and von Haam of this Faculty. It was natural, therefore, that it should eventually have been considered for the study and diagnosis of peripheral circulatory disease, and to date several favorable reports on its use have been published, principally by dos Santos, Lamas and Caldas (40 cases) and Allen and Camp of the Mayo Clinic (25 cases). We have ourselves reported 27 cases in a communication accepted for publication in the *Annals of Surgery*, and since that paper was written have increased the number to 74 cases. Yater and White have recently reported a case of arteriovenous aneurysm demonstrated by this method, as has Horton of the Mayo Clinic, and a similar case is included in our own series. All of these observers, like ourselves, believe that in the use of thorium dioxide (which we have personally used, like most of the others, in the form of thorotrast, Heyden) has been found the solution of the problem of arteriography of the extremities.

In our first report on the use of thorotrast we considered the subject in its various clinical aspects, and it is our intention in this communication to limit ourselves to its technical aspects. We may say, however, that increasing experience has confirmed our original opinion, that this method, when it is employed with the proper precautions, has no noteworthy deleterious effects, and we are glad to find our opinion corroborated by others who have been working with it even longer than we ourselves have.

The technical methods heretofore reported for the injection of thorotrast into the arteries all require at least one assistant. Allen and Camp use a tourniquet for arteriography of the lower extremities and a blood pressure apparatus for the arm and hand. Yater and White use the tourniquet, which they remove and replace between exposures. Pearse and Warren expose the artery and make the injection under direct vision, a technique that is obviously open to serious objection as a routine. We at first followed the plan of Allen and Camp, but we soon found that when more than one person was responsible for a procedure in which exact timing was so essential, breaks in technique were likely to occur, and we have therefore developed a very satisfactory method which can be carried out by one person and which eliminates the use of both incision and the

* From the Department of Surgery in the Louisiana State University Medical Center and the Surgical Service of the Medical Center in Charity Hospital, in cooperation with the Department of Radiology in Charity Hospital, New Orleans.

tourniquet. The method of Yater and White, we might say, is admirable if exposures in several different positions are required, but otherwise seems to us unnecessarily complicated.

In arteriography of the lower extremity, the position depends upon the vessels to be visualized. For the lower femoral vessels, the vessels about the knee, and the vessels of the leg and ankle, the exposure is almost lateral, the leg being rotated externally and the knee placed flat against the plate. An anteroposterior exposure, however, is best for visualization of the vessels of the foot (Fig. 1).

For arteriography of the lower thigh and the region about the knee the injection is made into the femoral artery within the femoral triangle. If the vessels of the leg and foot are to be visualized, the injection is made within the adductor canal unless the patient is very obese; then the technical difficulties are likely to be so great that, even though the films are less satisfactory than when the puncture is made lower down, the injection is made within the femoral triangle. In one or two such cases we cut down to the artery, but we do not like the technique and employ it only as a last resort.

Regardless of where the injection is made, the procedure is the same. The skin over the site selected is anesthetized with 1 per cent procaine and the artery is punctured with a No. 18 needle attached to a syringe filled with thorotrast. As soon as the puncture is accomplished, pressure is made with the thumb over the artery just proximal to the site of injection and is continued until all the thorotrast has been introduced. Then it is released and the exposure is made three to six seconds later, depending upon the distance between the site of injection and the location of the pathology.

When the injection is made in the adductor canal, 12 c.c. of thorotrast is quite sufficient for a detailed study of the vessels of the leg and foot, or for an anteroposterior view of the foot, while 20 c.c. is sufficient for a complete visualization of the vessels of the lower thigh and upper leg, as well as for the lower leg and foot when the injection is made into the femoral triangle. We have never used more than 30 c.c. even when injection had to be made into the femoral canal in an unusually tall and obese patient.

FIG. 1. Anteroposterior view of foot showing the vessels filled with thorotrast after injection of 12 c.c. into the femoral artery in the adductor canal in a patient with necrosis of the distal phalanges of the fourth toe from a crushing injury. Note that even the finer vessels are visualized, and note also the irregular deposits of calcium in the vessel walls.

Fig. 2. Anteroposterior view of hand and lower forearm of patient with malignant hypertension, after injection of 5 c.c. of thorotrast into the brachial artery in the antecubital space.

Visualization of the arterial supply of the upper extremity is very simple. We have personally limited our injections to the brachial artery, the exact site depending upon the portion of the extremity to be visualized. If the vessels about the elbow are to be included, the injection is made as high as possible, otherwise it is made correspondingly lower. If the axillary vessels are to be visualized, the injection must be made into the subclavian artery. A Wassermann needle is used, usually without any anesthetic, and just as soon as it is inserted the artery is occluded by digital pressure immediately proximal to the site of injection. The pressure is released and the roentgenogram is taken as soon as the injection is concluded. The amount of thorotrast used depends upon the size and length of the arm; 5 c.c. is usually sufficient, and in no case have we used more than 10 c.c. The vessels of the arm and hand are best visualized in the anteroposterior position (Fig. 2).

Since thorotrast, after it is diluted with blood, casts almost the same shadow as does bone, considerable confusion of detail may result if too long an exposure is made. We have found that the contrast with the bony structures is well marked if the technique is employed which is advised by Dr. Amédée Granger, of the Department of Radiology, who has cooperated with us throughout this study: 45 ma., 90 kv., 35 inches, 1 second exposure.

If the vein should be punctured instead of the artery, naturally there will be no visualization of the vessels, but this error can be promptly detected and the needle re-inserted; *if the artery has been punctured, bright red blood spurts periodically into the syringe, and the flow can be checked by pressure above the point of insertion, whereas if the vein has been punctured, there is a steady flow of dark blue blood, which is increased by similar pressure.*

On a few occasions, early in our work, we failed to get the needle into the artery and a small amount of thorotrast was injected into the adjacent tissues. In one such case about 3 c.c. escaped into the tissues of the antecubital space and there was moderate swelling of the entire region, with redness and slight pain; hot compresses were used and the condition cleared up within forty-eight hours. Roentgen examination of the area about a week later showed a dense, opaque mass of thorotrast within the tissues; examination eight months later (Fig.

3) showed the same mass with fine opaque strands leading from it, which we considered to be lymphatics. We could not, however, demonstrate the lymphatics or glands of the axilla. The escape of smaller amounts of thorotrast is apparently of no consequence, but we mention this case in detail to emphasize the need of care in making the puncture, for it has occurred to us that a similar accident in close proximity to a nerve might later terminate in fibrosis and even paralysis of the parts because of pressure.

It is exceedingly important that the artery be completely occluded proximal to the site of injection, and we have found, as we have already said, that this is best done by digital pressure applied by the operator himself. If the occlusion is omitted or is incomplete the vessels are seen only as faint outlines and the smaller vessels are not visualized at all. Furthermore, it must be remembered that while larger arterial vessels naturally fill more rapidly than the smaller ones, the smaller ones empty more slowly than the larger ones, which explains why occasionally a film is made in which the smaller vessels are visualized proximal to the column of thorotrast in the larger vessels. Such a roentgenogram is open to misinterpretation, as we proved in one of our own cases. On the basis of what we saw in the film we reported an occlusion of the lower femoral artery, but when amputation was done, in the lower third of the thigh because the circulation below the knee was inadequate, the vessel was found to be patent.

Our chief failures have occurred because of incorrect timing. In our first roentgenograms we frequently found the vessels only partly filled because we had made the exposure too soon (Fig. 4), or we found only the venous circulation visualized because

Fig. 4. Incomplete filling of the arteries of the lower leg and foot because exposure was made too soon after the injection of 20 c.c. of thorotrast into the femoral artery in the femoral triangle.

Fig. 3. Retention of thorotrast in antecubital space eight months after the accidental injection of 3 c.c. into the soft tissues of this region. Note the fine, radiating lines which are interpreted as lymphatics.

FIG. 5. Anteroposterior view of leg and foot of patient with arteriosclerotic gangrene before injection with thorotrast. Note the calcification of the vessels.

FIG. 6. The same patient six seconds after injection of 20 c.c. of thorotrast into the femoral artery in the femoral triangle.

we had delayed the exposure too long. Our recent roentgenoscopic studies on the rate of the vascular flow, which we shall mention shortly, have made our timing much more accurate, and we have found that in the average case the best results are secured by making the exposure in the lower extremity three to six seconds after completing the injection into the femoral artery and removing the pressure from it, the distance of the pathology from the site of injection being the determining factor (Figs. 5, 6 and 7).

FIG. 7. The same patient twelve seconds after the injection was completed. Note the filling of the veins of the leg and foot.

To date, we have employed arteriography in 74 cases, including:

1. Gangrene of various types, to demonstrate the vascular pathology. In addition, we have found the method of value in the occasional case to indicate the line of demarcation before it was clinically evident, and we have also found it useful in certain cases in establishing the safety of amputation at a lower level than seemed possible from the clinical evidence.

2. Embolic or thrombotic obstruction.

3. Angiospasm, to rule out obstruction from thrombosis or embolism In the 2 cases of this sort the onset was very suggestive of the latter pathology, and differential diagnosis by this method proved very useful.

4. Arteriovenous aneurysm of the femoral vessels. In the single case of this sort we were able to corroborate the work of Yater and White in a similar instance, and we are convinced that in this type of pathology thorotrast should prove very useful.

5. Fibroblastoma of the sciatic nerve, to rule out aneurysm (Fig. 8). In this case of familial neuroma, which will be reported by Miangolarra and Copland of this department, roentgen examination by the usual methods had proved the tumor to be distinct from the bony structures of the thigh, and further examination with thorotrast showed the femoral artery entirely normal except for a medial displacement by the tumor. Operation confirmed the diagnosis.

The interpretation of the roentgenograms is naturally the most important consideration in arteriography, and from the beginning of our work we have endeavored to be as accurate as possible. We made our first injections in animals, partly to assure ourselves of the harmlessness of the method and partly to familiarize ourselves with the roentgenographic appearance of injected vessels. Then we employed arteriography in normal subjects, in order to establish the proper standards of comparison, and finally we progressed to diseased subjects. Whenever it was possible we checked the clinical and the roentgenological findings against the findings of the pathologist in his study of the amputated limbs.

The most striking characteristic of the injected vessels in normal subjects (Fig. 8) is the distinct and regular vascular pattern which fades out gradually as the most delicate terminals are reached, and the orderly arrangement, so to speak, of the arterial supply, even in the fingers and the toes (Fig. 2). All the vessels, furthermore, are

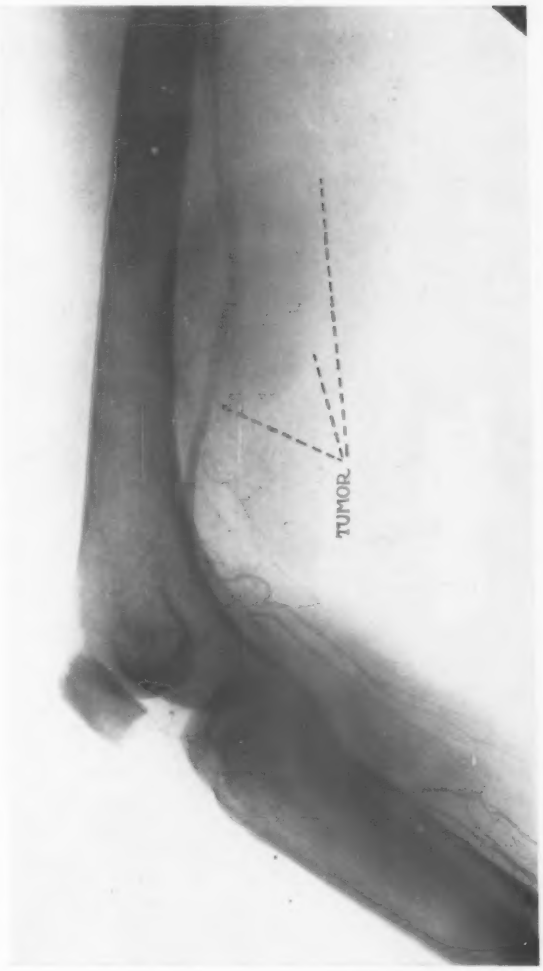

Fig. 8. Anteroposterior view of the femoral and popliteal arteries after the injection of 20 c.c. of thorotrast, showing displacement of the lower femoral artery by a tumor of the sciatic nerve. Note that the vessels are practically normal except for a very early sclerosis.

visualized, even the fine branches which arise directly from the large trunks. In arteriosclerotic vessels (Fig. 9), on the other hand, the main arterial supply is heavy, uneven, wavy and tortuous. The smaller vessels end abruptly rather than fade out, and the fine branches which arise directly from the main trunks are not visualized. The muscular branches are also very irregular, while the number of finer branches visualized is fewer than in the normal state. The lumina are markedly narrowed, and plaques of calcium are often

FIG. 9. Marked arteriosclerosis of the vessels of the leg and thigh, with thrombosis of the popliteal artery. Note the irregular pattern and the uneven outline and distribution of the vessels and the beginning formation of a collateral circulation around the knee. Twenty c.c. of thorotrast was used.

seen in the vessel walls. The existence of a collateral circulation is direct evidence of disease, and its irregularity is characteristic.

In embolic or thrombotic gangrene the column of thorotrast ends abruptly, there being no visualization of the artery or of its larger branches beyond the site of the block. If the obstruction is of long standing the collateral circulation is abundant. In our two cases of angiospasm we were able to demonstrate the patency of the great vessels of the legs; the lumina were smaller than normal, it is true, and the finer terminals were not seen, but the vascular supply, although diminished, was still adequate.

We have been particularly interested in the roentgenoscopic studies we have made with thorotrast on the rate of the blood flow through the extremities. In a patient with normal vessels and with no irregularities of pulse or blood pressure, we have found that even 10 c.c. of thorotrast injected into the femoral artery in the femoral triangle can be followed down to the foot, through the arteries and their finer terminals, and back through the venous circulation until it is lost by dilution or until it passes out through the femoral veins. Since this is so, it seems to us, although we have as yet had no opportunity to test the point, that such an examination with as little as 5 c.c. of thorotrast is likely to prove of value in locating the site of arterial obstruction by an embolus or thrombus.

We have noted a decided variation in the rate of flow between normal cases and cases of peripheral circulatory disease. In the normal patient it takes from six to nine seconds for the column of thorotrast, after it enters the blood stream, to pass from the femoral triangle down to the vessels of the foot, the return flow, naturally, being slower. In patients with arteriosclerotic vessels the flow is faster than normal, while in those with varicose veins we have found the rate of flow much slower, sometimes taking twenty-five seconds and more. We expect within the near future to make a detailed report on these special investigations.

CONCLUSIONS

We have employed arteriography with thorotrast in 74 cases to date, without the development of any immediate untoward

symptoms. We fully realize the possibilities of danger inherent in this agent, not only to the blood vessels in which it is injected but also to the cells of the reticuloendothelial system, but we believe that its relative safety, at least, has been established by its use in hepatosplenography over several years, by investigators of unquestioned verity, in doses far larger than we employ, and we have therefore felt justified in experimenting with it. Furthermore, we have used all possible precautions. Our dosage is always as small as possible and is always well within the proved limits of safety. We have selected our cases carefully; we have limited the method to persons of advanced age unless very real indications existed for its use earlier. We are making a periodic follow-up of our subjects, and while we naturally discount as entirely psychological the benefits which many of the patients have assured us have followed its use, we have seen as yet no case in which we consider that harmful effects have been produced.

We therefore believe that thorotrast as a diagnostic agent has a field of usefulness in arteriography of the extremities, and we are hopeful that our roentgenoscopic studies of the blood supply of the extremities will also prove of value.

In the present communication we have subordinated the clinical aspects of this investigation and have emphasized only the technical features of the method.*

We desire to express our appreciation to Dr. Urban Maes, Director of the Department of Surgery of the Louisiana State University Medical Center, and to Dr. Amédée Granger, Professor of Radiology in the Medical Center and Director of the Department of Radiology in Charity Hospital, with whose hearty approval and cooperation this work has been done. We are also grateful to the Heyden Chemical Corporation, manufacturers of thorotrast, for the cooperation they have given us.

* Since this paper was written, the number of cases in which the method has been employed has increased to 150 and includes 2 cases of popliteal aneurysm. No untoward results have been noted in any instance, and we have become increasingly certain of the practical value of arteriography with thorotrast in circulatory diseases of the extremities.

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ROENTGEN THERAPY OF HYPERPARATHYROIDISM*

By EDWIN A. MERRITT, M.D.,
and
EDGAR M. McPEAK, M.D.
WASHINGTON, D.C.

IT IS now an established fact that osteitis fibrosa cystica (von Recklinghausen's disease) is caused by hyperparathyroidism. There are certain other conditions of bone, such as Paget's disease, ankylosing types of polyarthritis, multiple myeloma, and giant cell tumors, which are closely allied and may be endocrine in origin although apparently not due to parathyroid dysfunction alone. Due to this fact they will not be considered in this presentation.

The true cases of parathyroidism (osteitis fibrosa cystica—von Recklinghausen's disease) present a most interesting group. Before proceeding with a description of their treatment we would like to enumerate briefly certain facts in regard to their incidence, symptomatology and laboratory findings. The condition occurs most frequently between the ages of thirty and sixty. Females are affected more often than males, although in our series there is an equal division. The cardinal symptoms are pain, asthenia, loss of weight, muscular weakness, anorexia and constipation. There is usually an accompanying secondary anemia and occasionally an elevation in temperature. Postural abnormalities are the rule in well advanced cases. The blood calcium is usually elevated and the serum inorganic phosphorus decreased, although there are authentic cases in which there was no variation in either. There is an increase in both the calcium and phosphorus content of the urine. Due to the increase in urine calcium, renal calculi are frequently associated with the bone changes. A general endocrine imbalance, especially an enlargement of the thyroid gland, is usually the rule.[1]

The roentgen findings are characteristic. The predominating change is a decalcification associated with multiple cystic areas and a uniform granular mottling.[4] The sites of predilection are the areas of most active bone growth, that is, the metaphyses of the long tubular bones.[8] The vertebral bodies are flattened and show compression fractures—some of them appear to have exploded. Pathological fractures of the ribs, vertebrae and long bones, in the absence of metastatic malignancy, would justify a tentative diagnosis of parathyroidism in any case. Indeed, any unexplained cystic bone disease should, in our opinion, be considered of parathyroid origin and the therapeutic test of roentgen therapy applied as a confirmatory diagnostic procedure.

Pain may be produced by pressure on the nerves by the deformed vertebrae but it is a question whether the hypercalcemia may not also of itself be productive of pain. The latter idea is supported by the prompt relief which follows either surgery or irradiation of the parathyroids.

There are now on record many cases o parathyroidism which have been cured by the surgical removal of one or more of the parathyroid bodies, but a review of the literature discloses a lack of information regarding their treatment by radiant energy. This study is undertaken with the idea of supplementing this latter deficiency.

At the present time there is no satisfactory medical treatment for this disease.

Surgery of the parathyroids has produced unquestioned cures although it seems to us, for the reasons stated below, a sound premise to assume that roentgen therapy should be given a trial in all cases before surgical measures are employed.

The etiology of parathyroid dysfunction

* From the Radiological Clinic of Drs. Groover, Christie and Merritt, Washington, D.C. Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

being obscure and the close interrelationship between all of the glands of internal secretion being acknowledged, it would seem that the most conservative form of

Fig. 1. Case 1. May, 1927. Roentgenogram of skull showing erosion in occipital region.

therapy should be instituted first, especially when this treatment produces equally good results and does not preclude other methods should they become necessary. It is also not known just how much of an increase in parathyroid secretion is necessary before pathological changes develop. If it can be compared to the amounts of hormone necessary to produce remarkable changes in other forms of animal development it will be a quantity so small as to be incomprehensible.

Hahn[6] reports some interesting facts regarding hormones which are well worth keeping in mind in considering this condition. He says: "Thyroxine, when injected into the American salamander (axolotl) in a single dose of a hundred thousandth of a grain suffices to promptly and positively bring about a metamorphosis from a gill breathing to a lung breathing animal, when this transition is delayed as it frequently is when the animal is in captivity." He further states, "A tadpole will develop slowly or not at all in iodine free water, but adding thyroxine; 1 part to 5-thousand million parts of water, brings about rapid metamorphosis."

Obviously then, in dealing with secretory substances whose presence cannot be seen, felt or determined and so infinitesimal as to be designated only in astronomical figures, the reëstablishment of the proper balance calls for a therapeutic measure less hazardous and more practical and scientific than radical surgery of the neck.

The parathyroid bodies, developing as they do from the third and fourth branchial pouches, may be situated anywhere from the cricoid cartilages down along the carotid arteries, trachea, etc., well into the thoracic cavity. The superior group, developing from the third branchial pouch, are fairly constant in position, although they may be buried in the substance of the thyroid gland and are then beyond any practical method of detection. The inferior group, arising from the fourth branchial pouch, vary considerably in both number and position.[11] In addition, numerous minute islands of parathyroid tissue may be scattered in the connective tissue and fat

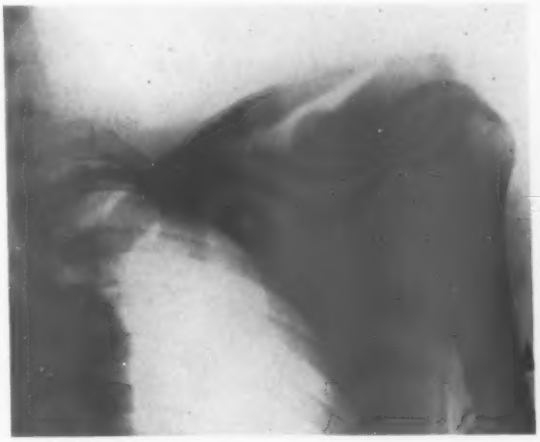

Fig. 2. Case 1. January 15, 1929. Roentgenogram of shoulder showing cystic areas with pathological fracture of the clavicle.

of the neck around the parathyroid glands proper and quite distant from them.[5]

MacCallum[9] has charted the location of the parathyroid bodies based on 67 dissections in human beings and his work em-

Fig. 3. Case 1. November, 1932. Roentgenogram of skull showing complete bone regeneration.

phasizes the lack of uniformity in regard to their situation.

The wide variation in both the amount and location of the parathyroid tissue offers a tremendous barrier to surgical intervention. This, however, does not prevail in roentgen therapy since uniform irradiation can be instituted over the entire cervical region.

Granting that the removal of an adenoma is a minor surgical procedure, it might be conceded a simple method except that the recognition is so difficult that it results in many surgical failures.

A definite enlargement or adenoma is not necessarily always present in these cases and, in the absence of macroscopic changes, the surgeon is faced with the difficult problem of how much and what to remove. This is well illustrated in the case reported by Hitzrot and Comroe.[7] Their case presented the typical bone changes but no enlarged parathyroid bodies could be detected either before or at operation. At the first operation a normal parathyroid body was removed with no clinical change. At a second operation two macroscopic and histologically normal parathyroid glands were removed from the opposite side of the neck with recovery. The patient subsequently developed tetany which was controllable by parathormone. This case affords conclusive evidence that the surgeon is unable to determine by the appearance of the glands after they have been exposed which ones should be removed. Ballin and Morse[1,2] have also removed normal glands with clinical success.

There is no such problem in the radiation treatment since a much more accurate control of the patient is afforded by this method.

Multiple adenomata occasionally occur and it would seem that radiant energy should be the method of election in their treatment since it is very questionable whether so much parathyroid tissue should be removed. Beck's case[3] in whom three parathyroid glands were removed, two of which were adenomatous, well illustrates this point. His patient developed tetany on the fifth day and died on the twentieth.

Where two or more therapeutic measures are equally efficacious the economic phase must be considered. Surgery requires hospitalization with its attendant expense, while irradiation does not. Two of our cases were bedridden and suffering excrutiating pain but were not hospitalized on account of their financial status. It has been our experience that the pain disappears relatively

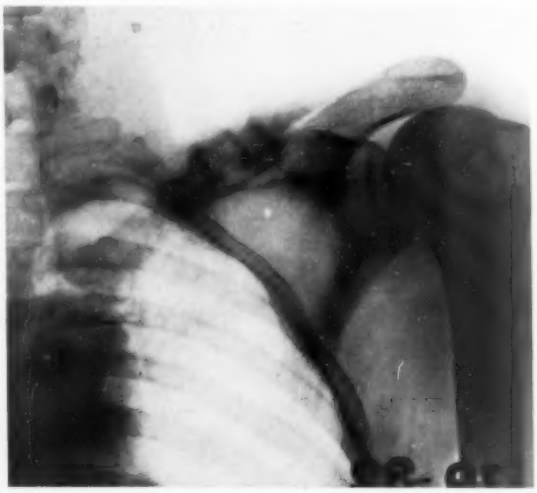

Fig. 4. Case 1. November, 1932. Roentgenogram of shoulder showing that cystic areas are practically entirely filled in. Ununited fracture of clavicle.

Fig. 5. Case II. May 16, 1931. Right knee showing cystic changes in the lower femur.

soon following therapy, enabling the patients to care for themselves.

The rationale of radiation therapy in the control of secretory glands is sound. The informed individual no longer questions the efficacy of this form of therapy in its influence over salivary, ovarian, pituitary, or thyroid function, and there is no reason to believe that the parathyroids are an exception in this respect.

If there are contraindications to roentgen therapy for parathyroidism they have not yet appeared. The literature furnishes thousands of cases where intensive roentgen therapy has been employed over the neck and, notwithstanding certain adverse opinions emanating from experiments on lower animals, we can find no evidence in our own experience or in the literature to justify an opinion that irradiation of the cervical region is ever contraindicated in parathyroid disease of the human being.

In the treatment of malignant growths we have, for the past year, followed the technique recommended by Coutard. It is, of course, scarcely necessary to point out

Fig. 6. Case II. October 12, 1931. Roentgenogram of right knee showing femur to be practically normal.

that the intensity of irradiation in Coutard's series is many times greater than that required to control either hyperparathyroidism or hyperthyroidism. We have personally investigated the blood calcium in 2 of our cases of malignancy of the cervical region, one of the larynx and the other of the cervical glands, each having received a total of 3,000 r at 200 kv., over a period of thirty days and the estimation made some weeks after treatment. In one the blood calcium was 12.2 mg. and in the other 9.1 mg. per 100 c.c. of blood.

We have not encountered nor does the literature reveal a case of tetany following roentgen therapy for any condition.

Treatments for hyperparathyroidism are ordinarily given at intervals of three weeks. The exposure of four areas is recommended, one over each side of the neck, one over the upper thorax anteriorly and one over the neck posteriorly. The following are the dosage factors employed: 140,000 volts; 5 ma. of current; 10 × 15 cm. fields; 6 mm. aluminum filter and an exposure of 240 r (measured in air) to each field.

FIG. 7. Case III. Roentgenogram of wrists showing cystic areas in the lower ends of both bones left side.

CASE REPORTS

CASE 1. R. F. P., white male, aged thirty-five, admitted to Veterans' Hospital, Washington, D.C., May 27, 1927.

The past history is unessential up to April, 1925, when he was hospitalized on account of a growth on the back of his head and enlargement of the postcervical glands. He complained at that time of intermittent headache and left earache. Remained in the Hospital until December, 1926. The growth and glands had slowly increased in size. The headaches became more frequent and there was "a gradual loss

of natural strength especially since head and glands started swelling." Patient stated he "noticed trouble with arms and legs, like paralysis, for some time."

On admission to Veterans' Hospital, Washington, D.C., May, 1927, the patient was found to be well developed, of good physique, but poorly nourished. There was a cardiac arrhythmia but no organic heart disease. The thorax and abdomen were negative. There was a mild secondary anemia. The blood Wassermann was negative. The report of the examinations by the radiologist and surgeons is as follows: "There is a very great degree of erosion of the post-occipital region (Fig. 1) and the parietal bones. There is an enormous symmetrical, semi-fluctuant tumor beneath the scalp covering the entire occipital region. There are large glands in the suboccipital area and below the left mastoid. Surgical interference impossible. Gland excised for biopsy." The pathological report was "small round cell sarcoma." Treatment: Roentgen therapy, 200 kv., 50 cm. skin target distance, 5 ma., 0.5 mm. copper and 1 mm. aluminum as filter, a 20 × 20 cm. field and a dosage of 1,200 r to each side of the head an 350 r to posterior occiput. Hospitalization continued at another Veterans' Hospital until March 29, 1928.

Fig. 8. Case III. Roentgenogram of wrists showing some bone regeneration in cystic area of both the radius and ulna.

Following the above roentgen therapy there was complete depilation of hair with desquamation of epidermis. Readmitted to Veterans' Hospital, Washington, D.C., March 29, 1928. Subject had been confined to bed for previous month during which time he had been treated for anemia; complained of dizzy spells and trembling. Had dyspnea and precordial pain. There was a mucopurulent, blood-tinged nasal discharge. There was no change in the size or character of the tumor on the head and the

Fig. 9. Case IV. Roentgenogram of spine showing typical decalcification and deformity of the vertebral bodies.

cervical glands were the same. Neurological examination was negative except for asthenia and muscular weakness thought secondary to the tumor.

Additional roentgen therapy was given using the same factors as enumerated above except that the posterior occipital area received a dosage of 600 r instead of the 350 r previously given. This produced complete depilation and intense erythema with some vesication.

Surgical opinion rendered in April, 1928: "Remarkable transformation, enormous mass decreased to one or two small nodules left side of original growth." Roentgen examination showed an increasing calcification in the skull. Discharged for observation elsewhere May 28, 1928.

Readmitted to Veterans' Hospital, Washington, D.C., October 26, 1928.

At this time the patient presented the cardinal signs and symptoms of moderately severe thyrotoxicosis. The basal metabolic rate was plus 34 per cent and the subject complained of great weakness and inability to talk at times. A bony tumor of the left clavicle was noted and found to be a pathological fracture through a bone cyst (Fig. 2).

The patient received the following roentgen therapy over each side of the cervical region: 140 kv., 5 ma., 10 inch skin target distance, 10 × 15 cm. fields, 6 mm. aluminum filter and an exposure of 240 r to each field. Six such series were given at intervals of three weeks between treatments.

Results. The patient's condition was definitely improved when discharged from the Hospital on May 15, 1929. In November, 1932, he was in good health and the skull and clavicle (Figs. 3 and 4) were restored to normal, although there is a non-union of the pathological

Fig. 10. Case V. January, 1932. Roentgenogram of right hip showing cystic changes in the region of the neck and head of the femur.

fracture of the clavicle. The patient remains well and free of symptoms at the present time, four and a half years since initial treatment and eight and a half years since onset of first symptoms.

The diagnosis in this case is based largely on the therapeutic response to irradiation of the parathyroids, which suggests the advisability of such a therapeutic test in obscure bone lesions.

Case II. (Previously reported.[10]) A. H. R., white female, aged thirty-four, first seen by us on May 16, 1931.

The past history is entirely negative until the early part of 1928, at which time she developed the signs and symptoms of thyrotoxicosis of a moderate degree. Had a subtotal thyroidectomy August 14, 1928. Improved following operation and remained well for one year, at the expiration of which time she had a recurrence of symptoms of hyperthyroidism. Developed stiffness in right knee during early part of 1930 which became worse, followed in a few months by pain which increased in severity to the point where she was unable to walk. Basal metabolic rate plus 35 per cent; pulse 98 and weight 95 pounds. The blood Wassermann was negative.

Fig. 11. Case v. January, 1932. Roentgenogram of right knee showing cystic areas in both the lower end of the femur and upper end of the tibia.

Fig. 12. Case v. November, 1932. Roentgenogram of right hip showing cystic areas of the neck and head of the femur healed.

Roentgenograms of the right knee (Fig. 5) showed cyst-like areas of bone destruction involving the distal end of the femur with some periosteal proliferation. Roentgen therapy. using same factors and dosage as employed in treating the parathyroids in Case I, was instituted. Eight treatments were given at intervals of approximately three weeks. There was complete relief from pain in the knee following the first treatment and a gradual progressive improvement in the patient's general condition until October 12, 1931, five months after initial treatment, when she was discharged as well. She had gained 25 pounds in weight, her basal metabolic rate and pulse were normal and the cystic areas in the right femur (Fig. 6) had practically completely healed. She remains well at this date which is over two years since she was first treated.

Case III. P.M.A , male, white, aged sixty. The history is unessential until March, 1929, when he began having pain along the left tendo Achillis. This was followed by pain and tenderness in both hands, forearms and shoulders. The blood calcium at this time was 12.8 mg. per 100 c.c. of blood.

In November, 1929, the patient states he was "seriously crippled" and consulted Dr. Joel E. Goldthwait of Boston who found a chronic arthritis with a decalcification of the bones. He returned to his home in Washington, D.C.,

Fig. 13. Case v. November, 1932. Right knee. Right femur and tibia practically normal.

and consulted Dr. Arthur C. Christie on November 29, 1932. Dr. Christie made a diagnosis of hyperparathyroidism based on the presence of cystic areas in the lower ends of the left radius and ulna (Fig. 7), a blood calcium of 12.6 mg. per 100 c.c. of blood and a serum phosphorus of 1.96 mg. per 100 c.c. of blood.

Ten roentgen treatments, using same factors as employed in the previous cases, were given over the cervical region at intervals of three weeks. There was a slight improvement in the cystic areas in the radius and ulna and a diminution in the pain following the second treatment. On June 29, 1933, the patient was clinically well. The blood studies at that time were as follows: calcium 9.03 mg. per 100 c.c. of blood and serum phosphorus 4.0 mg. per 100 c.c. of blood. Roentgenograms of the left forearm on September 15, 1933 (Fig. 8), show some evidence of healing in the cystic areas of both radius and ulna.

Fig. 14. Case vi. January, 1933. Left ankle showing cystic area, posterior aspect, of the os calcis.

Case iv. T. H., female, white, aged seventy, consulted us on October 28, 1932. Past history of no importance until April, 1932, when patient developed pain in lower back and the lower extremities. The pain became progressively more severe and gradually extended over the entire back. She was unable to walk and suffered intensely even in the recumbent position. Roentgenograms of the spine (Fig. 9) showed extensive decalcification and compression of the bodies of all of the lumbar and most of the dorsal vertebrae.

Fig. 15. Case vi. May, 1933. Left os calcis. Cystic area healed.

Roentgen therapy, using the same factors as in the above cases, was applied. Six treatments were given over the cervical region at intervals of three weeks. There was a marked diminution in the intensity of the pain follow-

ing the first treatment and the patient was free of pain following the third treatment.

On June 6, 1933, eight months after the first treatment, the patient was very confortable and was able to be up and attend to her usual duties. She has gone South for the summer so that no further check on the condition of her spine can be made at this time.

Case v. A., male, white, aged four and a half. Shortly after birth of patient mother suspected shortening of the right lower extremity; the measurements, however, were normal and a roentgen examination at that time indicated normal bones.

Roentgen examination of the lower extremities (Figs. 10 and 11) in January, 1932, showed shortening of the right femur with demineralization in the head of the femur, in the distal end of the femur and the upper end of the tibia.

Nine roentgen treatments were administered at monthly intervals over the cervical region, using the same technique as in the previous cases, and in November, 1932, roentgenograms (Figs. 12 and 13) showed practically complete bone regeneration. The patient is clinically well at the present time, November, 1933. This patient, in addition to the cystic bone changes, had a distinct growth of hair on the anterior aspect of the right thigh which was not present on the left. This suggests the additional factor of pituitary dysfunction.

Case vi. Male, white, aged six. Admitted to Children's Hospital, Washington, D.C., October, 1932; had cut the left heel on a piece of glass; this healed without any complications. A month later the patient struck his heel and a slight swelling developed. There was no evidence of skin damage or ecchymosis. On admission the heel was swollen, tender and quite painful. The temperature, pulse, respiration and white blood count were all normal.

Roentgen examination in January, 1933 (Fig. 14), three months after onset of symptoms, showed a decalcification of the bones of the left foot and a definite cystic area of bone destruction in the posterior, inferior portion of the os calcis. The blood calcium was 8.9 mg. per 100 c.c. of blood.

Three roentgen treatments, using the same factors as in the above cases, were given at monthly intervals over the parathyroid region. The pain was completely relieved following the first treatment. Roentgenograms in May, 1933 (Fig. 15), four months after the initial roentgen treatment, showed complete bone regeneration and the patient was clinically well and remains so to date.

SUMMARY

Six cases of cystic bone disease which have been either entirely cured or definitely benefited by roentgen therapy over the parathyroid region are reported. The facts presented point strongly to the etiological rôle of parathyroid dysfunction in cystic bone disease and to the efficacy of roentgen treatment of the parathyroids in such lesions.

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IRRADIATION IN THE TREATMENT OF PSORIASIS*

By RIEVA ROSH, M.D., *Radiation Therapist*
Bellevue Hospital
NEW YORK CITY

NEXT to acne, psoriasis is the most prevalent of the dermatoses, and because of its long duration and its tendency to recur it is of marked importance mentally, physically, and economically, to the individual sufferer.

How to treat psoriasis properly is an age-old problem, for the disease is found in all countries, occurs at all ages, in both sexes, and in every class. Its occurrence is not affected by climate or time; not by food, habits, occupation or environment of individuals suffering from this ailment.

Psoriasis is so widespread that it is easily recognized. The disease may persist for years, at times changing its character and occurring with rapidity or disappearing in one place and appearing in another. Occasionally the disease may vanish suddenly as if by magic, and lead to a fancied idea of cure. The disease may affect all body surfaces except the mucous membranes.

Many causes for this disease have been suggested, such as focal infections, intestinal flora, protein sensitization, peculiarities in food or drink, and heredity, but none of these has been proved specific although in some instances the occurrence of the disease had seemingly appeared in association with the previously said causative factors.

As yet no definite cure has been discovered for psoriasis although all sorts of treatments have been suggested. With the

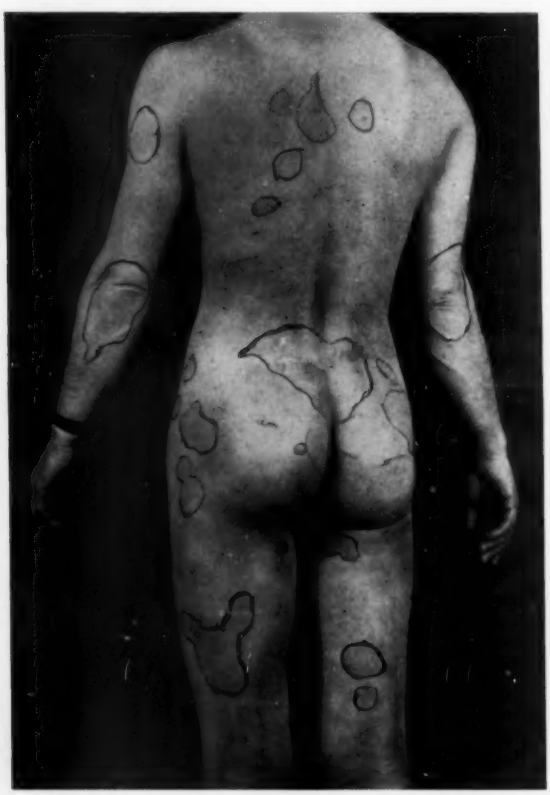

FIG. 1. Case 1.

FIG. 2. Case 1.

From the Radiation Therapy Service, Bellevue Hospital, New York City, Ira I. Kaplan, M.D., Director.

advent of irradiation, this too was suggested as a therapeutic measure for the control of psoriasis. Wallon treated a woman of seventy-one by applying radium (108 mc.) to the splenic region, with a pronounced, but temporary, improvement. In another case, radium treatment for rectal cancer led to improvement of a psoriasis eruption occurring elsewhere in the same patient. In the author's opinion, the effect in these cases was due to protein action from the absorption of liberated protein in the irradiated regions.

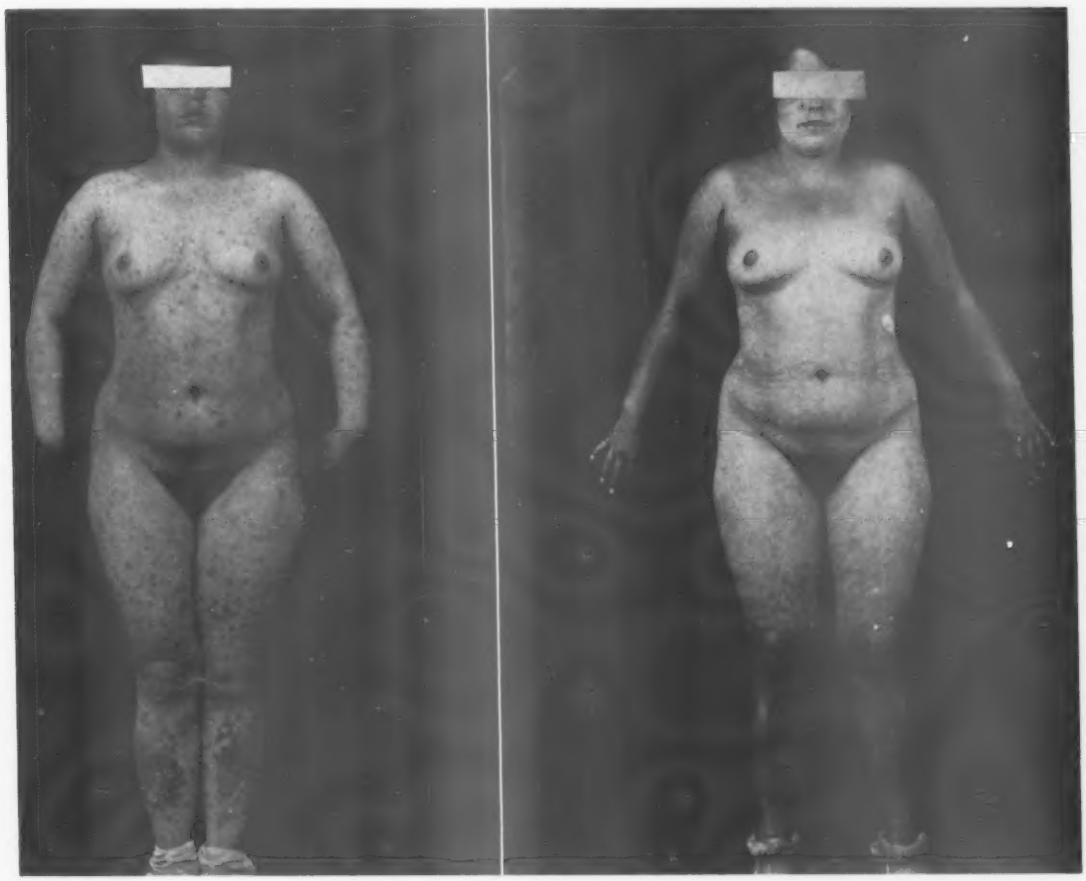

Fig. 3. Case 11. Before and after treatment.

In 1921, Foerster and Foerster suggested irradiation over the thymus gland for psoriasis; and Jamieson reports 50 cases successfully treated in this manner over a period of six years. Schneider, however, basing his conclusions on study and experience, agrees with Martenstein and Haucks that there was no positive roentgen-ray action on the thymus and that it was not correct to assume a physiological relationship between the thymus and psoriasis. On the other hand, Gawalowski's observations appear to corroborate the hypothesis of Samberger and Brock that the roentgen ray does alter the function of the thymus gland. His study of the changes in the blood following irradiation of the thymus showed that the end products of destroyed blood cells do not directly influence the parakeratotic diathesis, but have an indirect effect on psoriasis through subsequent inflammatory changes which increase the defensive forces of the body. He also

showed that an increase in the function of the thymus gland caused a slight increase in formation of pigment. In his series, 65.8 per cent of the cases treated by irradiation over the thymus produced successful results. In Bellevue Hospital, roentgen radiation is applied to the sympathetic nervous system, which at the same time affects the thymus tissue.

Because we are as yet uncertain about the effectiveness of this method, we are for the time being using it empirically. The results of this method of treatment on our patients who have had psoriasis for years have been encouraging. In some cases where the lesions existed for twenty years or more, and the patients were referred to our clinic only after all other forms of treatment had been tried, including superficial roentgen therapy, good results have followed our method of therapy. The patients themselves date their improvement

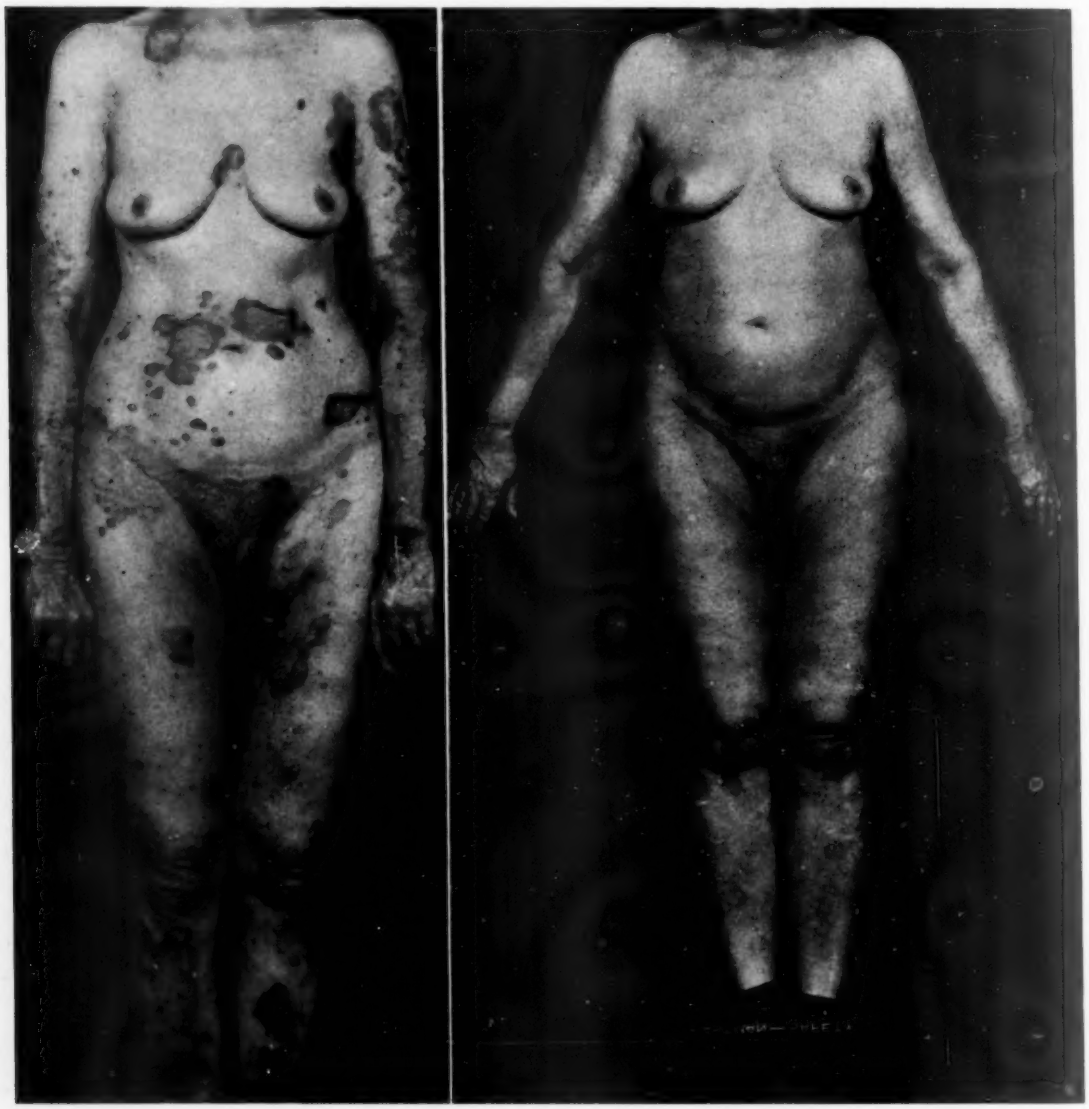

Fig. 4. Case III. Before and after treatment.

from the time this form of treatment was begun, and we are more or less forced to believe that this method of treatment is responsible to a certain extent for the good results accomplished.

Our method of treatment consists in the application of high voltage roentgen rays to the spine at those levels which correspond with the nerve supply to the affected areas of the body.

During the period of 1924–1933, we treated 46 cases of generalized psoriasis —25 male and 21 female. Of these, 22 were treated locally with superficial roentgen therapy; and 24, since 1928, were treated with deep roentgen therapy over the upper and lower thoracic spine. In these latter cases the disease had existed for periods varying from six to twenty years. None of the patients were hospitalized and they were able to follow their usual mode of life. No effects attributable to the season of the year or climate were observed. In most cases, following treatment, patients noticed at first an increase in itching which was soon followed by a complete cessation of this symptom. About three weeks after treatment it was noted that the color faded from the center of the affected areas, the scales became loosened, and the surrounding infiltration in the skin was diminished.

In most cases a second series of treatments was given after a period of six to eight weeks, during which time a majority of the areas were replaced by a brownish pigmentation. Complete disappearance of the lesions occurred only in three to six months after the administration of the last treatment. In some persistent cases a year elapsed before the body was freed from the psoriasis.

REPORT OF CASES

Case I. J. S., aged thirty, admitted March 1, 1928, with psoriasis lesions all over the body. He had previously been treated with all kinds of local medications. Superficial roentgen treatments were administered to the local areas, with only slight improvement. During August, 1928, treatment was given with high voltage roentgen rays over the cervical, dorsal and lumbar spine, 860 r to each area. By October, 1928, all the lesions had disappeared. Unfortunately, the original lesions were not photographed, but Figure 1 shows the intermediate stage of brown pigmentation at the site of the lesions. Figure 2 shows complete healing four and one-half years after treatment and during which time there was never a recurrence.

Case II. V. S., aged nineteen, female, single. Admitted April 15, 1930, with a history of psoriasis of eight years' duration over entire body and head. At times the rash would disappear in the summer but recurred invariably after short intervals. She had received "injections" by a doctor, without relief. Deep roentgen therapy was given to the upper and lower dorsal spine—a 75 per cent erythema dose to each area. In August, 1930, the face and head were completely clear but some areas were still present over the body and chest. During January, 1931, another course was given to the upper thoracic spinal area—a 100 per cent erythema dose. In March, 1931, the condition was completely cleared up, and there has been no recurrence for two years (Fig. 3).

Case III. E. McK., female, aged seventy, single. Admitted October 17, 1930, for generalized psoriasis of eleven years' duration, growing progressively worse and spreading. The patient also has a cardiac lesion. Deep roentgen therapy was given to the upper and lower thoracic spinal areas—100 per cent to each. The lesion cleared up rather slowly, and required more therapy at three and four months' intervals. Finally, complete clearing up of the condition was obtained by March, 1931 (Fig. 4).

Several other cases treated with this method have likewise shown equally good results.

SUMMARY

A method of treatment for psoriasis is described.

Cases are reported showing the treatment results over a period of four and one-half years, two, and one and one-half years respectively.

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CLINICAL OBSERVATIONS ON CARCINOMA OF THE UTERINE CERVIX AFTER RADIATION THERAPY*

By HENRY SCHMITZ, M.D., F.A.C.S., F.A.C.R.
CHICAGO, ILLINOIS

AT THE end of 1928, six hundred and sixty-two private cases of carcinoma of the female genitalia had been treated by irradiation. The charity cases which were included in all former reports have been omitted as they have been transferred to the tumor clinics of the Mercy Free Dispensary and the Cook County Hospital. Among the 662 cases were 502 primary and 160 recurrent carcinomas. Table 1 shows the number and per cent of the cases for the various regions of the genital tract. It is seen that 80 per cent of the carcinomas were located in the cervix. Therefore control of malignant disease of the female genitalia must be centered in the early recognition and immediate adequate treatment of cervical carcinoma. Statistics prove that early localized carcinomas adequately treated have a five year curability rate of 80 to 90 per cent. Clinical research comprising a study of the causative factors, the earliest tissue changes leading to malignancy and the symptoms and signs of beginning cancer nodules has brought about greater progress in the diagnosis and prognosis of cancer than all other investigations. The results of clinical research and the improved methods of diagnosis should become the common property of the entire medical profession. The control of cancer can only be achieved by whole-hearted cooperation between the investigators, specialists, and clinicians.

The 398 primary carcinomas of the cervix offered an opportunity to study the influence of early diagnosis on the extent of the disease and on the five year good end-results. The study incidentally included the significance of age, gravidity and parturition in cancer of the cervix.

TABLE I

NUMBER AND PER CENT OF CARCINOMAS OF THE FEMALE GENITALIA FOR PRIMARY AND RECURRENT MALIGNANCIES

Region	Primary Carcinomas		Recurrent Carcinomas		Total Carcinomas	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Vulva	20	3.98	6	4.28	26	3.95
Vagina	7	1.39	2	0.65	9	1.16
Cervix uteri	398	79.28	129	80.63	527	79.61
Corpus uteri	38	7.60	5	3.13	43	6.50
Ovaries	39	7.75	18	11.31	57	8.78
Total	502		160		662	

THE INFLUENCE OF TIME DURATION AND GROWTH EXTENT ON THE CURABILITY OF CERVICAL CARCINOMA

The time elapsed from the appearance of the first symptom to the beginning of treatment in each of the four clinical groups and the five year good end-results obtained within these time periods in each clinical group are tabulated in Table II.

It is seen that 242 cases, or 60.81 per cent of the total number, were admitted during the first semester or half year period. Seventy-one cures were obtained, or 29.33 per cent of the 242 cases; 99 cases,

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

TABLE II

THE TIME ELAPSED FROM THE APPEARANCE OF THE FIRST SYMPTOMS TO THE BEGINNING OF TREATMENT AND THE FIVE YEAR GOOD END-RESULTS OBTAINED IN EACH CLINICAL GROUP

1. The Time Elapsed and the Number of Cases in the Clinical Groups

Clinical Groups	The Time Elapsed													
	Silent	1	2	3	4	5	6	to 9	to 12	to 18	to 24	to 30	to 36	Total
I	12	10	4	4	2	1	1	1			1			36
II	1	4	8	10	5	2	6	3	9	2	3			53
III		13	18	18	16	13	24	21	30	16	6	3	2	180
IV		7	14	13	12	11	13	9	19	15	9	4	3	129
Total	13	34	44	45	35	27	44	34	58	33	19	7	5	398

2. The Five Year Good End-Results for Months and Clinical Groups

Clinical Groups	Months													
	Silent	1	2	3	4	5	6	7–9	10–12	13–18	19–24	25–30	31–36	Total
I	11	7	4	4	2		1	1			1			31
II	1	2	3	6	4	3	2	2	2					25
III		1	6	3	4	3	4	3	7	2				33
IV				1										1
Total	12	10	13	14	10	6	7	6	9	2	1			90

TABLE III

THE FIVE YEAR GOOD END-RESULTS FOR HALF YEAR PERIODS AND CLINICAL GROUPS

A. Semesters

	I	II	III	IV
Number of cases	242	92	33	31
Per cent of cases	60.81	23.11	8.29	7.79
Five year good end-results	71	31	9	1
Per cent of number in each semester	29.33	33.69	27.27	3.23

B. Clinical Groups

	I	II	III	IV
Number of cases	36	53	180	129
Per cent of total number of cases	9.27	13.25	45.23	32.25
Five year good end-results	31	25	33	1
Per cent of total number in the semester	87.87	47.17	17.78	0.78

Total number of cases is 398;
Total number of five year cures is 90, or 22.67 per cent.

or 23.11 per cent, were admitted during the second half year period with 31 cures, or 33.69 per cent of the 99 cases; 33 cases, or 8.29 per cent, were admitted during the third semester with 9 five year cures, or 27.27 per cent of the 33 cases; and 31 cases, or 7.79 per cent, came during the fourth half year period or later with 1 cure, or 3.23 per cent of the 31 cases. If the five year good end-results are determined for each clinical group, then the percentages are in clinical Group I, 87.87; in clinical Group II, 47.17; in clinical Group III, 17.78; and in clinical Group IV, 0.78 (see Table III and Fig. 1).

The influence of time within the first

three semesters is negligible as the per cent of five year good end-results forms almost a horizontal line around the 30 per cent ordinate and then drops very abruptly to 3.23 per cent (see Fig. 1). This may be explained by the observation that all cancers grow silently for some time before causing symptoms. Some carcinomas may be highly malignant, have a high histological malignancy index of Grade 4, and grow very rapidly. Other carcinomas have a low histological malignancy index of Grades 1 and 2 and grow rather slowly. The highly malignant carcinoma is highly radiosensitive and even if of a comparatively large size may react favorably to irradiation. The carcinoma with a high maturity is more radioresistant and requires a high radiation tissue dose to undergo resolution. If the diameter of the growth is within 6 cm., irradiation can destroy it. If the tumor is larger, it is doubtful whether it may ever be completely arrested. The radium cannon or the 800,000 volt roentgen rays perhaps may enable us to treat the larger growths more successfully. It would lead too far

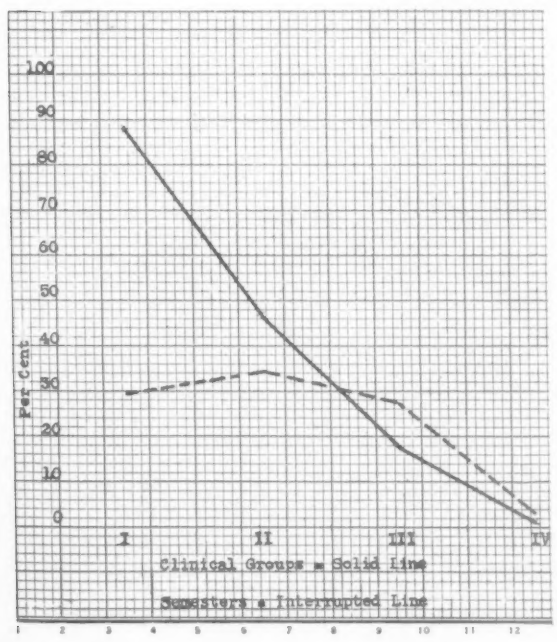

FIG. 1. The five year good end-results for the clinical groups in comparison with those for half year periods.

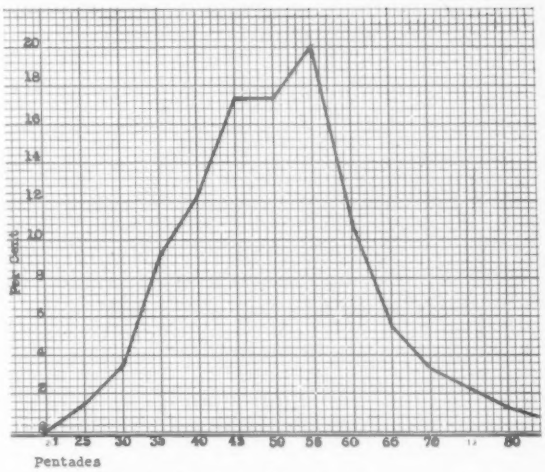

FIG. 2. The incidence of age in five year periods.

afield to discuss the histological grading in detail. Reference is made to the publications in the literature.[2,3,4,7]

The extent of the growth plays a very important rôle in prognosis of radiation treatment. The clinical groups express the extent of the growths. The number and per cent of five year cures were plotted against the clinical groups. The resulting graph has almost a straight slope, extending from 87.87 per cent in the clearly localized, symptom-free carcinomas of clinical Group I, to 47.17 per cent in the beginning ulcerating stage carcinoma, characterized by contact bleeding, of clinical Group II, to 17.78 per cent in the growth invading the parametria or regional lymph nodes, and characterized by hemorrhages and putrid or brownish discharge, of clinical Group III, and to 0.78 per cent in the fixed growth with hemorrhages, putrid discharges and pain of clinical Group IV. The absolute five year cure percentage is 22.62 as 90 patients among 398 were well at the end of five years.

The extent of the growth at the first examination and immediate and adequate treatment definitely govern the prognosis and curability of carcinomas. The early, beginning, clearly localized but silent cancer offers a five year curability rate of 80 to 95 per cent. The degree of histological malignancy is of some importance in re-

lation to the time duration of the disease, its clinical extent and ultimate prognosis.

THE SIGNIFICANCE OF AGE

The influence of age on carcinoma of the uterine cervix in this series shows that the climax of frequency was reached between the ages of fifty-one and fifty-five; that the frequency began to increase rapidly from the thirty-sixth year on and again dropped rapidly during the ages of fifty-six to sixty. Within the fifth and sixth decades two-thirds, or 66.42 per cent, of the carcinomas appeared (see Fig. 2). This observation agrees with the well-known statement that carcinoma of the cervix appears most frequently during the menopausal period, but no age is exempt.

THE INCIDENCE OF PREGNANCY OR LABOR

The number of pregnancies and labors in the 398 carcinoma patients were ascertained and the percentages were calculated in order to plot them. The number of pregnancies of 400 women free from cancer who entered the hospital with non-gynecological complaints were determined, transposed to percentages and plotted to serve as a norm or average (see Fig. 3). Women of either group beyond the fourth labor or

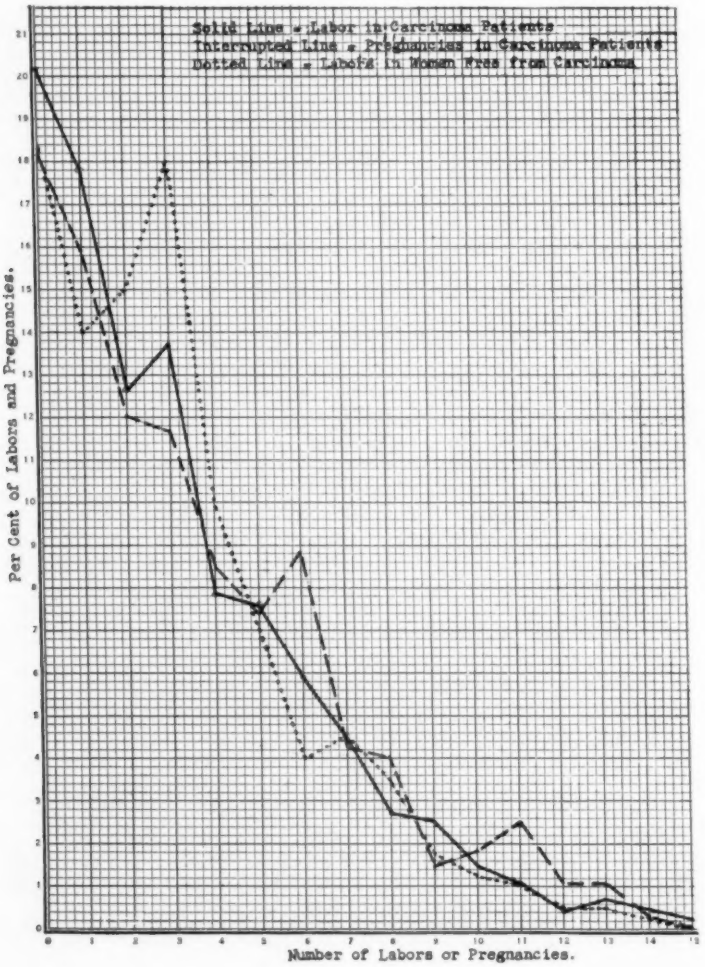
Solid Line = Labor in Carcinoma Patients
Interrupted Line = Pregnancies in Carcinoma Patients
Dotted Line = Labors in Women Free from Carcinoma
Per Cent of Labors and Pregnancies.
Number of Labors or Pregnancies.

Fig. 3. The correlation of the number of pregnancies and labors in patients with carcinoma of the uterus to labor curve of non-carcinomatous women.

pregnancy show a fair parallelism in the graphs. The most obvious dislocations occur in the women with three and two pregnancies or labors. The carcinomas are much higher in frequency in the nullipara and unipara and of less frequency in the duipara and tripara and gravidas than the pregnancy rate in normal women. These women form the large majority, having practically two-thirds of all pregnancies. Sterility, uni-gravidity and one child sterility are mainly due to infections. The accidents of labor and abortion frequently terminate in low grade infections of the genital organs and always of the vaginal portion of the cervix. The chronic infection of low degree appears to be the precursor of malignancy. Sterility is in the greater number of such women the result of remnants of previous infections. This is substantiated by the dominance of carcinoma in the nulliparas and uniparas which are almost all preceded by chronic cervicitis. The conclusions are corroborated by the observations of many clinicians, as Schiller,[5,6] Bailey,[1] and Schmitz et al.[8]

To prevent carcinoma we must look for chronic infections and treat them adequately whenever found during post-partum examinations, during routine physical examinations and during periodic health surveys. The yearly examination of every married woman and the adequate treatment of every chronic cervicitis, whether silent or causing symptoms, offer the only method for the prophylaxis and prevention of carcinoma of the cervix.

SUMMARY

1. The extent of the growth of carcinoma of the uterine cervix is directly related to the curability rate. The time elapsed from the occurrence of the first symptom to the beginning of adequate radiation treatment apparently does not influence the end-results of radiation treatment. The freely movable, clearly localized growth shows from 80 to 90 per cent five year good end-results. It can only be discovered by routine periodic health examinations.

2. Carcinoma of the uterine cervix is probably always preceded by a low grade type of chronic inflammation. The discovery of chronic cervicitis by follow-up after infections, abortions and labors and during routine or periodic health examinations and its adequate treatment will prevent cancer later on. If a silent early carcinoma is found during such examinations and adequately treated at this time permanent healing may be achieved in almost every case.

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THICKNESSES OF ALUMINUM TO BE USED IN ADDITION TO COPPER FILTERS

By A. MUTSCHELLER, PH.D.
NEW YORK CITY

IT IS common practice in deep roentgen therapy to place on the patient's side of the copper filter, an additional filter of aluminum, for the purpose of absorbing the secondary radiation from the copper. But quite often, as in the proverbial story of emptying the entire medicine bottle at once for a more pronounced effect, the thickness of this additional aluminum filter

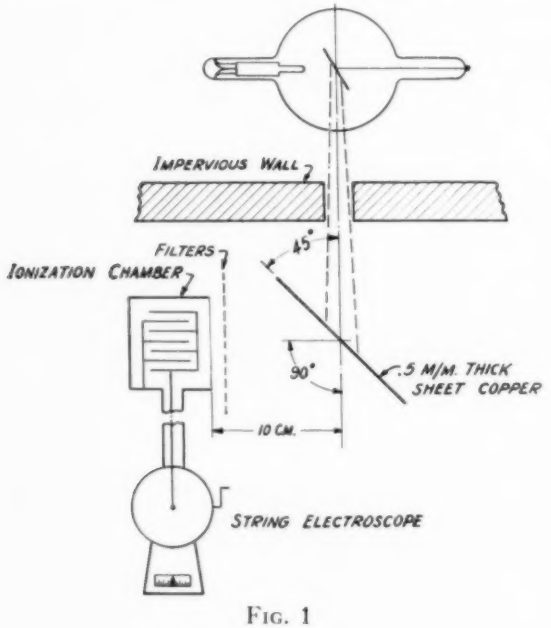

FIG. 1

has been increased to obviously unreasonable dimensions, so that the question of how thick it really should be seems worthy of more detailed consideration.

Ordinarily, when copper filters are employed, the voltages applied to the roentgen tube are above those which excite the characteristic radiation of copper, i.e., 8.92 kv. Therefore, it is to be expected that the radiation intensity leaving the copper filter produces, in the direction away from the surface of the tube, a secondary radiation which consists to a large extent of characteristic radiation and of a smaller amount of recoil radiation. Only when the voltages applied to the tube are very high does the recoil radiation exceed the characteristic radiation of copper, but in all cases there is a secondary radiation emitted from the copper, which should be absorbed by an aluminum filter.

However, it has been definitely shown* that, for short wave length radiations, aluminum is relatively a rather effective absorber, or, in other words, aluminum is not a useful filter for the reason that it reduces the intensity over the entire spectrum to almost a uniform extent. Aluminum, therefore, is not a filter which further homogenizes the radiation or decreases the ratio between the surface and depth doses as filters of the heavier atomic elements do, but rather it simply decreases all the wave length components of the spectrum to an almost uniform extent. It is therefore evident that aluminum, per se, under such conditions, is not a useful filter and that its thickness should not exceed the minimum thickness required to stop the secondary radiation from the copper. To illustrate this, the following readings were made:

Equipment: Constant potential generator and ring focus air-cooled therapy tube

182—minimum wave length kv.
4—ma.
50—cm. distance
0.5—mm. Cu filter.

The following readings were obtained:

0.5 Cu	18.8 r/min.	100 per cent
0.5 Cu 1 Al	17.9 r/min.	95 per cent
0.5 Cu 2 Al	16.7 r/min.	89 per cent
0.5 Cu 3 Al	16.0 r/min.	85 per cent
0.5 Cu 4 Al	15.0 r/min.	80 per cent

Therefore, it becomes evident that the presence of an aluminum filter is responsi-

* Mutscheller, A. Quality average of continuous x-ray spectrum. *Radiology*, 1929, *12*, 283–289.

ble for quite a substantial decrease of radiation intensity and that therefore its thickness should be not more than the minimum sufficient to absorb the soft radiation from the copper filter.

The next question that arises is what filter thickness is necessary to reduce the secondary radiation to such a minimum that the dose which it delivers to the skin, in excess of the directly administered dose, can be neglected.

in approximately 10 sheets of white paper is probably the characteristic radiation of copper, corresponding to about 9 kv. Its intensity is very readily absorbed in several layers of paper and, in all certainty, completely in 0.50 mm. Al. Yet there seems to be present a very faint radiation intensity which can be assumed to be true scattered radiation from the copper.

Figured out in actual radiation intensity, it is found that the intensity is 0.005 r/min.,

Scattered at right angles to the beam

No filter	32 sec.	=0.16	r/min. E.D.t.*	37 hr.
1 sheet of writing paper	302 sec.	=0.017	r/min. E.D.t.	333 hr.
2 sheets of writing paper	350 sec.	=0.015	r/min. E.D.t.	377 hr.
3 sheets of writing paper	400 sec.	=0.013	r/min. E.D.t.	434 hr.
0.28 mm. aluminum	1000 sec.	=0.0054	r/min. E.D.t.	10,500 hr.
1.00 mm. aluminum	1050 sec.	=0.0050	r/min. E.D.t.	11,300 hr.

* E.D.t = Erythema dose time.

An experimental set-up was made, which is shown in the accompanying drawing (Fig. 1). A beam of roentgen rays was caused to pass through an opening 6×4 cm. and to fall upon a copper filter at a 45° angle to the direction of the beam. At 90° to the beam and at 10 cm. from the copper, there was placed an ionization chamber which has a sensitivity of 0.0854 r per scale deflection.

Readings were taken with the chamber open, i.e., with no material in the space between the filter and the 45° copper filter. Then several sheets of ordinary white writing paper were interposed and, finally, sheets of aluminum were used to absorb the secondary radiation from the copper. The radiation consisted of 4 ma. of tube current, 182 kv. minimum wave length kilovolts, and a filter thickness of 0.5 mm. Cu. The above readings were obtained. Evidently these results indicate that the very soft radiation which is emitted from the copper and which is readily absorbed

or that, on an average, if there were no loss due to recovery, and if 750 r would be required to produce an erythema dose, it would take over 10,000 hours to produce an erythema dose. Therefore, it would seem that this radiation intensity is so small that its relation to the directly applied radiation intensity can be neglected as unimportant.

Having pointed out that the addition of aluminum filters to a copper filter causes a loss in the general radiation intensity without producing any appreciable gain in the homogenization of the radiation, it may be derived from this experiment that a filter of 0.25 mm. or, at most, of 0.5 mm. Al, would appear to be entirely sufficient to absorb all harmful radiations from a copper filter and that no useful gain would result from the use of thicker plates of aluminum or any other kind of additional material as secondary filter intended for the absorption of secondary radiation from copper filters.

HANS R. SCHINZ, M.D.
Zurich, Switzerland
PRESIDENT, FOURTH INTERNATIONAL CONGRESS
OF RADIOLOGY

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Thirty-fifth Annual Meeting: Hotel Wm. Penn, Pittsburgh, Pa., Sept. 25–28, 1934.

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20th Annual Meeting: Atlantic City, N.J., 1935.

EDITORIAL

WHO CAN PRACTICE MEDICINE?

THERE has been developing in the United States a system of medical practice which deserves much greater attention from the medical profession than it has received. We refer to the so-called "corporate practice of medicine." Some of the aspects of this practice have been investigated by the Bureau of Economics of the American Medical Association and various plans have been described in the Journal from time to time under the heading "New Forms of Medical Practice." The forms there described have been frankly commercial ventures, organized by laymen or by doctors with a flair for business organization, with the announced purpose to sell the services of physicians to groups of laymen, usually under some form of periodic payment. Such plans have in them many of the worst elements of contract practice. They invariably result in a great increase in the cost of medical service, since the corporation absorbs from 40 to 60 per cent of the funds paid in. Under such a system the doctor becomes the paid hireling of a corporation which controls his practice and makes a profit from it. Wherever it has been widely adopted, the results are wholly pernicious both to the medical profession and the laity alike.

Another aspect of the "corporate practice of medicine" has received less attention because it has been fostered by medical colleges and hospitals, which the physician naturally regards as friends and allies rather than competitors in the practice of medicine. The medical college is chartered for purposes of teaching and research and the hospital to furnish hospitalization and certain facilities for the use of physicians in their practice. Recently some universities and hospitals have found it convenient and profitable to engage directly in the practice of medicine in various ways. In some cases charges are made for the professional services of members of the full-time teaching staff of a university, the fees being collected and assigned to the treasury of the university; in others, hospitals organize workmen's compensation clinics, solicit work from insurance carriers and furnish the medical service through interns, residents or other paid members of the staff, the fees being collected and retained by the hospital; in still others, hospitals have engaged to include certain types of medical service in group hospitalization or flat-rate insurance plans.

In all of these instances the universities and hospitals are engaging in the corporate practice of medicine by collecting and retaining fees for medical service. That such practices are harmful to the medical profession and must result eventually in harm to the public is plain to all who are familiar with the trends of corporation practice.

There are many who admit the validity of objections to corporate practice of medicine by *community* hospitals who contend that *university* hospitals must be made an exception. That such a position is untenable can be shown by only a brief analysis. The primary purpose of a university hospital is to assemble patients to be used as clinical material in the teaching of medical students. The medical staff of such a hospital consists of physicians appointed *primarily* to teach in the medical school and hospital and *secondarily* to furnish the usual medical care to the patients of the hospital. Patients are cared for gratuitously or on a less than cost basis with a clear understanding that they may be used as teaching material. This has come to be regarded as an acceptable and proper social arrangement. Up to this

point there is no conflict. It is only when university hospitals enter the general hospital field by accepting patients not in need of eleemosynary care, and who have no intention of submitting themselves as clinical material, that they become subject to exactly the same conditions that should apply to general hospitals. A university is chartered for education and research and has no authorization either by license or otherwise to enter into the practice of medicine in any of its branches. When a university through its hospital receives money for the medical services of its staff physicians and appropriates that money to its own use, the conclusion is inescapable that it has departed from its proper functions for which it was chartered and has entered the field of medical practice.

Universities should be even more careful than other institutions to respect the rights of society and the medical profession; society has created and supports them, and their functions of research and education are dependent upon the medical profession. There is the further consideration that they owe it to the student body to set a proper example with regard to professional practice and ideals and especially to refrain from such practices as will interfere with and make more difficult the careers of the very students whom they are training for the practice of medicine.

The justice of the objection of the medical profession to the corporate practice of medicine by hospitals is readily admitted by the majority of physicians in the case of surgeons, internists, and nearly all specialists. It seems plain to everyone that the hospital should not collect fees for their services. In the case of the radiologist and the clinical pathologist, however, thinking becomes confused and expediency is likely to govern instead of principle. The confusion results because of the fact that the hospital must furnish space to house these departments, must invest a considerable amount of money in apparatus and meet the cost of upkeep. Such considerations, however, do not invalidate the principle that the hospital corporation should neither fix nor collect fees from patients for the services of the clinical pathologist or the radiologist. An adjustment of the total fee must be made in order that the hospital may receive payment to cover its overhead of operation including heat, light, janitor service, etc., also payment to cover obsolescence of apparatus and a certain amount as rental for the space occupied. The corporation should not expect to make a profit from the operation of either of these departments. All of the above details are simple problems of administration and can be arranged on sound ethical lines once the principle is admitted that the hospital must not engage in the corporate practice of medicine.

Recently it has been proposed to separate the technical aspects of radiology from the professional aspects so that the hospital may be responsible for all that pertains to technique and may make a charge for such service, while the radiologist is responsible for the professional services and charges his own fee for them. In theory this plan seems to embody correct principles in that it recognizes the professional standing of the radiologist but in practice it has in it the seeds for great harm. It must be clear to every experienced radiologist that separation of the technical and professional aspects of radiology must eventually alienate all radiological work from the radiologist and place it under the direction of the hospital. The problem is the large one of the future development and progress of radiology. Progress can take place only when the radiologist has control of his department and full responsibility for its operation. The technical part of his work is an absolute essential to his success. It has been only by constant attention to the development of many different types of technique that the radiologist has been able to bring his art to its present point of excellence. The evidence is so convincing on this point that no experienced radiologist would be

willing to relinquish control of technical roentgen-ray work. It is a professional and not a hospital function, an actual essential in the practice of radiology.

The clinical pathologist and the radiologist happen to be on the firing line just at present in a battle which involves every branch of medicine. That other branches of the profession now feel comparatively safe is no reason why they should remain inert or actually assist hospital corporations to take over and control these particular specialities of medicine. We have a right to expect the entire profession to uphold the pathologist and radiologist in their efforts to remain free practitioners of medicine. Any other course is short-sighted and can result only in damage to both the medical profession and the public.

The unit for medical service is the individual physician; this is not only so in reality but its validity and necessity are recognized by the state in that license to practice medicine is always issued to an individual physician and not to an institution or corporation.

The important question now is "Who shall practice medicine?" Must medical practice be institutionalized and centralized and thoroughly regimented under control of corporations directed by laymen or can it remain a free profession? The answer is in the hands of the medical profession.

Arthur C. Christie

As this number goes to press, the entire scientific world is saddened by the death of Mme. Marie Curie which occurred at Sallanches, France, on July 4. A detailed account of Mme. Curie's life and work will be published in an early issue of the Journal.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa.
Annual Meeting: Hotel William Penn, Pittsburgh, Pa., Sept. 25–28, 1934.

American College of Radiology
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting: Atlantic City, N.J., 1935.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 321 Michigan St., Toledo, Ohio.
Annual meeting: Atlantic City, N.J., 1935.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y.
Annual meeting: Memphis, Tenn., Dec. 3–7, 1934.

Radiological Section, Baltimore Medical Society
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore.
Meets third Tuesday each month, September to May.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif.
Meets on the third Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. F. B. Bogart, Medical Arts Bldg., Chattanooga, Tenn.
Annual meeting: San Antonio, Texas, November, 1934.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. L. Voltz, 115 Myrtle Ave., Richmond Hill, N.Y.
Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y.
Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt.
Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio.
Meets third Monday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. Otto Glasser, Cleveland Clinic.
Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida Radiological Society
Secretary, Dr. W. McL. Shaw, 418 St. James Bldg., Jacksonville, Fla.
Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill.
Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

Michigan Association of Roentgenologists
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis.
Meets monthly. Place of meeting designed by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston Mass.
Meets monthly on third Friday, Boston Medical Library.

New York Roentgen Society
Secretary, Dr. C. W. Schwartz, 33 E. 68th St., New York.
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N.C.
Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. F. C. Rulison, Medical Arts Bldg., Syracuse, N.Y.
Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif.
Meets annually, during meeting of California Medical Association

Pennsylvania Radiological Society
Secretary, Dr. W. E. Reiley, Clearfield, Pa.

Philadelphia Roentgen Ray Society
Secretary, Dr. Thomas Loughery, Germantown Hospital.
Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital.
Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Club
Secretary, Dr. W. K. Mueller, University Club Bldg.
Meets first week of each month. Time and place of meetings designated by president.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston.
Meets at time and place of South Carolina State Medical Association.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Tennessee Radiological Society
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg., Chattanooga, Tenn.
Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Department of Roentgenology Staff Meeting.
Secretary, Dr. C. B. Pierce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Roentgen Club
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monghly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

Virginia Roentgen Ray Club
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Luis Fariñas, Animas 110, Havana, Cuba.
Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St. London, W. 1., or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Douglas Thomas, 12 Collins St., Melbourne, Australia.
Meets monthly at Melbourne from March to December.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Indian Radiological Association
Secretary, Sd. Subodh Mitra, 148 Russa Rd., Calcutta.
Meets annually in January and at such places and times as the Council may appoint.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. J. Boine, Avenue des Allies, 134, Louvain, (Belgian).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summer time.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Française d'Electrothérapie et de Radiologie Médicale
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April in different German cities, at least once in five years in Berlin. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent Secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Maracine 30, Bucharest, Rumania.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR, in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw.
Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summer time.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summer time.

Society of Medical Radiology of Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. H. Schuermann, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Society of Roentgenology
Meets first Tuesday each month, October to July.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike, Kyoto, Japan.
Meets bi-monthly on third Sunday.

ROENTGEN-RAY EXHIBIT AT A CENTURY OF PROGRESS

When in Chicago this summer do not fail to visit the exhibit on the first floor of the Hall of Science intended to show the layman visitor the wide scope and manifold uses of roentgen rays in diagnosis.

While sponsored by the Chicago Roentgen Society the exhibit was made possible by the material aid of the following societies and manufacturers, to whom A Century of Progress and the Chicago Roentgen Society hereby express the most thankful appreciation:

The American Roentgen Ray Society
The Radiological Society of North America
The Chemical Foundation
Eastman Kodak Company
Westinghouse X-ray Company
General Electric X-ray Corporation
Standard X-ray Company
Picker X-ray Company
Dupont Film Mfg. Corporation
Buck X-Ograph Company
Philips Metalix Corporation
George W. Brady and Company
Patterson Screen Company
H. G. Fisher and Company

While a roentgen-ray diagnostic exhibit for the lay public is somewhat new it is quite in line with the spirit of other medical exhibits at the Fair. Some six hundred films show the stages and variations of twenty-five types of disease, selected because of their pathological significance and because of the important rôle the roentgen ray now plays in their diagnosis. The basic material is truly scientific. A panel showing human monsters, placed in the corridor, is intended to attract visitors.

The Chicago Roentgen Society wishes to convey hearty appreciation also to a number of roentgenologists who contributed generously of their interesting films when called upon. Some of them were so kind as to prepare an entire section ready for mounting. In most cases they sent in valuable films which were returned after being copied to a uniform size. A list of those contributing scientific material follows:

Allen, Lewis G., Kansas City, Mo.; Allison, Robert G., Minneapolis, Minn.; Aspray, Joseph, Spokane, Wash.; Beeler, Raymond C., Indianapolis, Ind.; Bromer, Ralph S., Bryn Mawr, Pa.; Chamberlain, W. E., Philadelphia; Cheney H. H., Ottawa, Canada; Cole, Lewis Gregory, New York City; Davis, Kenneth S., Los Angeles; Doub, Howard P., Detroit, Mich.; Ernst, Edwin C., St. Louis, Mo.; Evans, Wm. A., Detroit, Mich.; Granger, Amedee, New Orleans, La.; Herrman, Wm. G., Asbury Park, N. J.; Habbe, J. Edwin, Milwaukee, Wis.; Heacock, Chas. H., Memphis, Tenn.; Kahn, Max, Baltimore, Md.; Kelly, James F., Omaha, Nebr.; Kirklin, B. R., Rochester, Minn.; Lafferty, Robert H., Charlotte, N. C.; Manges, Willis F., Philadelphia; Menees, Thomas O., Grand Rapids, Mich.; Newell, Robert R., San Francisco; Nichols, Bernard H., Cleveland, Ohio; Overgaard, Anders P., Omaha, Nebr.; Palmer, Dorwin L., Portland, Oregon; Peden, Joseph C., St. Louis, Mo.; Pfahler, G. E. and Vastine, J. H., Philadelphia; Pirie, A. Howard, Montreal, Canada; Pohle, E. A., Madison, Wis.; Richards, Chas. M., San Jose, Calif.; Rigler, Leo. G., Minneapolis, Minn.; Rowe, Edward W., Lincoln, Nebr.; Rowe, W. T., Rumford, Maine; Stephenson, Frank B., Denver, Colo.; Stewart, Wm. H., New York City; Upson, Wilbur O., Battle Creek, Mich.; Watkins, W. Warner, Phoenix, Arizona.

Whether or not such an exhibit will serve to educate the public in the value and limitations of roentgen rays is somewhat of a problem. An attempt is being made to get the public reaction as a guide to any future attempts along this line. Naturally such an exhibit must be over the average visitor's head but he cannot fail to note many uses of x-rays foreign to his experience.

H. E. Potter

FIRST INTERNATIONAL CONGRESS OF ELECTRORADIOBIOLOGY

The International Society of Radiobiology announces that His Excellency Benito Mussolini, on account of the favorable advice of the National Council of Research, approved the initiative to call an International Congress of Electroradiobiology. This First International Congress of Elec-

troradiobiology will be held from September 10 to 15, 1934, in the Doges Palace at Venice.

The Congress will be presided over by His Excellency the Marquis Guglielmo Marconi, President of the Royal Academy of Italy, President of the National Council of Research, State Senator, and by His Excellency, Count Guiseppe Volpi di Misurata, State Minister, State Senator.

The object of this Congress is to invite physicists, chemists, biologists, naturalists, and physicians for a discussion on the biological actions of all radiations, in order to coördinate the respective investigations. The biologist will learn from the physicist the theoretical and experimental basis of the physical researches on the vibratory and corpuscular phenomena. The physicist and the physico-chemist will learn from the biologist what the influences are that these phenomena have on cellular elements, complex tissues and on organic processes. Moreover, the organizers of the Congress hope to determine a new radiobiological tendency of many present physical and biological investigations.

The subject of this Congress deserves the most earnest consideration and great interest, and this is the reason for the great support received from many well-known scientists of every country, viz., Prof. Emil Abderhalden, Halle a S.; Alexandre Belak, Budapest; Rita Brunetti, Cagliari; Alexis Carrel, New York; A. Castaldi, Cagliari; Arthur H. Compton, Chicago; William D. Coolidge, Schenectady; D'Arsonval, Paris; Duc de Broglie, Paris; Friedrich Dessauer, Frankfurt a M.; Ducceschi, Padoue; Carlo Foà, Milan; Albert Fischer, Copenhagen; Alexander Gurwitsch, Leningrad; Otto Glasser, Cleveland; Gola, Padoue; C. P. Haskins, Schenectady; Herlitzka, Torino; R. Kienböck, Wien; N. K. Koltzoff, Moscow; Svend Lomholt, Copenhagen; L. Lichtwitz, New York; J. Magrou, Paris; Robert A. Millikan, Pasadena, Calif.; D. G. Marinesco, Bucharest; E. Moreau, Clermont; G. A. Nadson, Leningrad; S. S. Nehru, Fatehpur, India; M. Nemenow, Leningrad; J. L. Pech, Montpellier; Ludwig Pincussen, Berlin; Pugno-Vanoni, Padoue; V. Riviera, Perouse; Claude Regaud, Paris; Angel Roffo, Buenos Aires; Sir. C. V. Raman, Bangalore, India; O. Reche, Leipzig; Bruno Rossi, Padoue; G. Viale, Genes; S. Valentiner, Clausthal-Zeller; Otto Warburg, Berlin; R. W. Wood, Baltimore, and many others.

The application of radiations to medicine and therapy will not be taken up or discussed at this Congress. The Congress intends to study only the chemical and biological phenomena in respect to radiations.

For further information, request may be made to the General Secretary of the Congress, Dr. Giocondo Protti, San Gregorio 173, Venice, Italy.

The following is taken from an article entitled "Alarums and Excursions" by Cuthbert Andrews read before the Society of Radiographers, at the British Institute of Radiology, on January 17, 1934, and published in the *British Journal of Radiology*, April, 1934, *7*, 246–252. Since it calls attention in a most interesting way to a side of roentgenological practice which should not be forgotten, namely, the humanitarian, it seems worth reprinting:

The Little Old Lady in Black

All of you, who have had any experience of work in hospital, know the little old lady in black. She sits on the bench, or on a chair in the corridor, usually a little apart from the other waiting patients. The habitués gather together in little knots of three or four, and discuss their ailments, their maternal experiences and the shortcomings of their husbands. To these veterans, a visit to the 'orspital is something in the nature of an outing, and from it they derive a certain degree of pleasure.

But the little old lady in black is of a different breed. If she can, she will draw her tiny body into a corner, until the chief thing noticeable about her is her thin, white face, with a pair of bright eyes, like a bird, except for the strained look of anxiety which she cannot keep out of them.

In her working hours she is an office-cleaner —not a very remunerative profession, but often permanent. She will tell you that she has "cleaned the same gentleman for eleven years," and if you asked her employer, he would probably tell you that during that time he has never missed a pen-nib. Of course, eighteen shillings a week isn't much to live on, after paying Lloyd-George's stamps, but she has a son who works as a warehouseman, and he helps her as much as he can, although since he got married, of course he can't do what he used to. So there isn't much left for clothes and such-like, and her best black has done duty on special occasions for many a year. Shoes and such-like are the trouble; her daughter-in-law did her best to make her respectable for the hospital, though; and if you are really determined, you can get as clean with a kettle of nice hot water and a hand-basin, as you can with them big regular baths.

When her turn comes, she will jump up nimbly enough, and in response to your "get up on to the table," she will probably answer, "Yes, miss." If she comes again, she will probably call you "nurse" or "sister," as she is quick to notice; but this is her first visit, and she uses the form of address to which she is most accustomed.

In spite of her brisk, sure movements, if you watch her as she settles herself on the table, you will see that she is breathing too quickly for comfort, and there is a tiny rush of colour coming and going in her face. She finds it difficult to keep her fingers as quiet as she is accustomed to do. In short, this little old lady, with her quick, quiet ways, and her air of self-reliance, bred of years of unspectacular hardship is really scared to death. When she told the doctor about the pains she had been having all these past months, and he said she must be X-rayed, she hadn't the faintest idea of what they would to with her. She obeyed, because, of course, you must obey the doctor, and anyway, something must be done about these pains because they had started interfering with her work. And, of course, that would be the most terrible thing of all. Suppose she were really ill, and couldn't go to her job, what would happen then? What would happen?

So, by herself, she has braved the first terrors of these half-dark passages and rooms, with their sudden queer noises; and now the moment has arrived when she lies on her back, with all these horrid iron things round her, and not enough light to see what they are going to do to her, now she is at their mercy. . . . But she's got to get well, and keep her job, and perhaps it won't be very bad, and perhaps after all, a bottle of medicine will . . .

A large proportion of you who are here this evening are going to exercise your profession, perhaps for years to come, in one or other of the many hundreds of hospitals of this country. I want to ask you to remember that there is a humanitarian, as well as a utilitarian side to the work which you will have to do. Those of you who are just commencing will meet, very soon, the little old lady in black. You will meet also the nervous child—not the screaming, kicking variety which can be pacified by a sweet, but the child whose silent terror will move you, if you have the perception which you should have. And you will meet the man who has "been feelin' a bit queer, like," and whose death warrant you are going to help to sign.

And I want you to realise and remember how you can help. All of us who are in any way connected with medical X-ray work, should sometimes stop and remember that we live on the sufferings of other people, and largely on the sufferings of the poor. Our food, our clothes, our pleasures, our luxuries—they are the fruits of the misfortunes of others. It is a terrible thing to have to admit. Doctors know it of themselves very well, but they *dare* not let their minds dwell upon it. If they did, they could not do their work. They must perforce harden themselves to the sight of suffering, that their brains may work coolly to alleviate it. Much of the cynical and apparently callous manner of medical men is simply a cloak adopted in self-preservation. But you have no such excuse. You can allow yourselves to remain sympathetic, and can show your sympathy in a practical way in your work. The terrible side of disease does not come frequently before your eyes. As radiographers you do not meet at firsthand terrible outward mutilation, heartrending physical suffering, nor the horror of the operating theatre. You draw your bonus on other peoples' suffering in clean and comparatively placid surroundings—as I do, myself.

So, when you meet the little old lady in black, will you give her a kindly and cheerful word, and try to allay her fears, and make things a little easier for her in her ordeal. Try not to think of her just as a "patient," or a "pelvis"

or a "case," but as a poor woman who is in danger of being broken after a hard fight. And perhaps, when they come to remove that stone, half as big as your fist, which she has in her kidney, her last thought as she goes under will be "'ow kind they was to me when I was in the X-ray."

And such shall be your reward.

RESOLUTION

TENTATIVE FORM OF RESOLUTION FOR ENDORSEMENT BY AMERICAN ROENTGEN RAY SOCIETY: OF MOORE SCHOOL OF ELECTRICAL ENGINEERING AND HENRY PHIPPS INSTITUTE PHYSICAL ROENTGEN RAY RESEARCH

WHEREAS, a group of engineers directed by Charles Weyl at the Moore School of Electrical Engineering have been working in collaboration with Dr. F. Maurice McPhedran and his staff at the Henry Phipps Institute, both of the University of Pennsylvania, under a grant made by the National Tuberculosis Association, for the past five years, and

WHEREAS, during these five years and the five years preceding them, the above mentioned group has studied in detail roentgenographic apparatus and methods of technique from both the engineering and clinical viewpoints with special reference to roentgenography of the chest, and

WHEREAS, as a result of these studies and researches, valuable standards for the selection and testing of roentgenographic machines and auxiliary apparatus and materials have been established and papers have been published from time to time in the leading technical journals and consultations both personal and by mail have been conducted with roentgenologists, technicians and executives and engineers of the roentgen-ray manufacturers resulting in mutual benefit to all parties concerned, and

WHEREAS, these researches and studies have reached the point where it becomes apparent that their continuance will be made beneficial to all progressive roentgenologists,

BE IT RESOLVED that this Society appoint three members to represent it on a committee including the above mentioned group and endorse the general purposes and activities of these researches in order to give them the proper official status with members of this Society.

THE AMERICAN COLLEGE OF PHYSICIANS

Philadelphia, 1935

The American College of Physicians will hold its Nineteenth Annual Clinical Session in Philadelphia, April 29–May 3, 1935.

Announcement of these dates is made particularly with a view not only of apprising physicians generally of the meeting, but also to prevent conflicting dates with other societies that are now arranging their 1935 meetings.

Dr. Jonathan C. Meakins, of Montreal, Que., is President of the American College of Physicians, and will arrange the Program of General Sessions. Dr. Alfred Stengel, Vice-President in Charge of Medical Affairs of the University of Pennsylvania, has been appointed General Chairman of local arrangements, and will be in charge of the Program of Clinics. Mr. E. R. Loveland, Executive Secretary, 133–135 S. 36th Street, Philadelphia, Pa., is in charge of general and business arrangements, and may be addressed concerning any feature of the forthcoming Session.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

A Practical Treatise on Diseases of the Skin for the Use of Students and Practitioners. By Oliver S. Ormsby, M.D., Clinical Professor and Chairman of the Department of Dermatology, Rush Medical College of the University of Chicago; Dermatologist to the Presbyterian and St. Anthony's Hospitals, and the Home for Destitute Crippled Children, Chicago, Illinois. With revision of the Histopathology, by Clark Wylie Finnerud, B.S., M.D., Assistant Clinical Professor of Dermatology, Rush Medical College of the University of Chicago; Assistant Attending Dermatologist to the Presbyterian Hospital, Chicago, Illinois. Fourth edition, enlarged and revised. Cloth. Price, $11.50. Pp. 1288, with 619 illustrations, and 3 colored plates. Philadelphia: Lea and Febiger, 1934.

This large volume is the fourth edition of Ormsby's very complete treatise on diseases of the skin and the publishers claim, apparently with justification, that every known skin disorder is considered. Thirty-six new diseases are described and 124 new illustrations have been added. Some of the more important new sections deal with tularemia, thrombo-angiitis obliterans, dermatomyositis and scleredema adultorum. The first 114 pages make up an elaborate introduction in which symptomatology, etiology, pathology, diagnosis, prognosis and therapeutic measures are covered in a general way. A revision of the histopathology by Clark Wylie Finnerud indicates that the author recognizes the trend toward a more scientific basis for dermatological diagnosis. The illustrations are of excellent quality and appear in ample numbers. The descriptive matter is well written and the book is undoubtedly one of the best atlases available for those who wish to diagnose difficult skin lesions. However, to the radiotherapist the volume is a great diasppointment. The author states in his introduction that roentgen rays have become almost indispensable and that he has used them for a long period. He then describes MacKee's method of measurement very briefly and throughout the remainder of the book either gives no information relative to dosage and technique or uses terms so vague that his work could hardly be duplicated. No space is devoted to a description of modern ionization methods of measurement. When confronted with squamous cell carcinoma he loses courage, as do most modern dermatologists who have not had experience with efficient dosage, and recommends surgery. Although malignant tumors in the mouth are described, nothing is said of the importance of radium therapy in their care. If the therapeutic section of this book could be augmented by concise data written with the aid of a radiotherapist its field of usefulness would be markedly increased and it could be freely recommended as one of the best dermatological reference books.

Charles L. Martin

The Clinical Management of Horseshoe Kidney: A Study of Horseshoe Kidney Disease, its Etiology, Pathology, Symptomatology, Diagnosis and Treatment. By Robert Gutierrez, A.B., M.D., F.A.C.S., Chief of Clinic of the Department of Urology, James Buchanan Brady Foundation of the New York Hospital; Assistant Attending Surgeon, New York Hospital, etc. With a Foreword by Dr. Edmond Papin, Paris. Cloth. Price, $3.00. Pp. 143, with 52 illustrations. NewYork: Paul B. Hoeber, Inc., 1934.

This interesting and instructive monograph on one of the rare anomalies of the urinary tract originally appeared in three successive numbers of the *American Journal of Surgery*, December, 1931, January and February, 1932. The subject is presented under the following headings: Introduction, Classification, History and Literature, Embryology, Anatomic Structure, Etiological Factors, Pathology, Symptomatology, Diagnosis, Report of Cases, Treatment, Summary and Conclusion.

A study of 25 cases of horseshoe kidney forms the basis of this presentation. A detailed report is given of each case. The volume is profusely illustrated with roentgenograms, drawings and autopsy material. A long list of references to the subject is supplied.

The author believes that this renal anomaly should be regarded as a distinct disease entity and has thus for the first time presented the subject as horseshoe kidney disease. He describes the so-called horseshoe kidney syndrome, which is an essential feature of the clinical diagnosis. Urography, however, is the procedure upon which the diagnosis of horseshoe kidney must depend. Emphasis is placed upon the important rôle that roentgenography has taken in bringing the importance of this condition to the attention of the physician. The author describes "a horseshoe pyelographic triangle" which he regards as pathognomonic for this type of renal anomaly.

This volume, which is exceedingly well presented, will be found of special interest to urologists and roentgenologists.

Karl Kornblum

Practical X-ray Therapy. By Hugh Davies, M.A. (Oxon.), M.R.C.S., (Eng.), D.M.R.E. (Camb.), Officer-in-charge of X-Ray Therapy, King's College Hospital; Honorary Assistant Radiologist, The National Hospital, Queen Square. Cloth. Price, 8s. 6d. Pp. 134, with 47 illustrations. London: J. & A. Churchill, 1934.

This very brief book is, according to the author, designed only for the medical student and the radiological student, and not for the expert. The first 50 pages are devoted, for the most part, to a description of methods of dosage measurement and the factors affecting dosage. The pastille methods are described in considerable detail but their inaccuracies are pointed out and they are not highly recommended. Although illustrations of some of the newer tubes and machines, mostly those made by one manufacturer, are included, practically nothing is said in the text about tubes or machine construction.

A few pages are devoted to the theory of the action of irradiation on dividing cells. However, information relative to the grading of tumors and doses adequate for their destruction is omitted.

The second half of the book includes chapters on diseases of the skin, blood, nervous system, lymph glands, secretory glands, bones and joints and urogenital system. All of this material is crowded into 64 small pages and the plan of therapy for each condition is of necessity reduced to the briefest possible formula. For instance, malignant disease of the female pelvis is covered in little more than a page and tumors of the testis are discussed in a paragraph containing eight lines. Some parts of the book, particularly the section dealing with diseases of the brain and spinal cord, indicate that the author has some valuable clinical information available which would make good reading if fully presented. It is also interesting to note that many of the techniques given are modifications of Coutard's fractional massive dose method, the exact results of which would greatly interest American radiologists if they had been included in statistical form.

This reviewer feels that such a sketchy treatise is of doubtful value to the novice and the medical student. To him who reads nothing more, radiation therapy must seem a group of simple procedures, one of which is designated for each disease by rule of thumb. He is not impressed with the wealth of clinical investigation and research which has made the method a very complex but useful tool in the hands of well-trained physicians. Neither is he furnished with statistical data which would enable him to evaluate the various procedures and compare them with other plans of treatment.

Charles L. Martin

Les Syndromes Douloureux de la Region Epigastrique. By René A. Gutmann, Physician to the Hospitals of Paris. Second edition, revised and enlarged. Two volumes. Paper. Price, 240 francs. Pp. 1180, with 629 roentgenograms and 330 drawings. Paris: G. Doin et Cie., 1933.

Lest the title may lead to the assumption that this is a diffuse and academic presentation of medical diagnostics in a restricted field, it may well be stated that these volumes constitute an exhaustive treatise on the clinical, roentgenologic, and therapeutic aspects of diseases that affect the upper abdominal organs, excepting only those of the liver, pancreas, spleen, and transverse colon. More specifically the work is in the domain of gastroenterology, covers the organic diseases of stomach, duodenum, and gallbladder, deals with ptosis and the functional dyspepsias, and ends with a chapter on complications following operation on the stomach, duodenum, and gallbladder. Outstanding, of course, among the various sections are those which pertain to gastric ulcer, gastric cancer, duodenal ulcer, and biliary disease.

Not rarely the lament is heard that modern

clinicians depend too much on laboratory aid for diagnosis and consequently slight the clinical examination. Those who voice such laments will be pleased with Gutmann's approach. He says: "In the great majority of cases, at the end of a well conducted interrogatory, the diagnosis should be made, and the various other methods will only serve to confirm it." Accordingly he devotes the first section to the clinical syndromes of epigastric pain in general and that of peptic ulceration in particular. Thereafter, as he deals with individual diseases he first discusses the purely clinical features of the lesions.

Yet, notwithstanding the author's essential status as a clinician, he realizes the indispensability of the roentgen ray and presents a roentgenologic survey and atlas of peptic diseases that excels those to be found in many strictly roentgenologic texts. In this field Gutmann has had the constant cooperation of eminent roentgenologists such as Ledoux-Lebard, Puthomme, and Garcia-Calderon, and this has been supplemented by contributions from several foreign roentgenologists. The illustrations cover the subjects thoroughly, are well organized and of high quality.

On the whole, the entire work admirably reflects the broad experience, industry and thoroughness of the author and merits more than conventional praise. Clinicians, gastroenterologists, roentgenologists, and surgeons alike will find pleasure and profit in its pages.

B. R. Kirklin

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

ISOLA, ARMANDO. Le sinostosi patologiche della volta e del cranio facciale. (Pathological synostoses of the skull and face.) *Radiol. med.*, Dec., 1932, *19*, 1382–1438.

The author divides pathological synostoses into those of the face and those of the skull. A skull with premature synostosis tends to show compensatory hypertrophy along the axis of the affected suture while there is limitation of development perpendicular to the suture. The compensatory hyperdevelopment parallel to the suture is a primary anomaly while other deformities resulting from it are secondary. It is hard to determine just which changes are primary and which secondary in the face, as it is not a simple curved surface like the skull but a complex structure with various arches and plane surfaces in which the lines of force are lost.

Pathological synostoses of the skull produce various types of skull, such as the oxycephalic, platycephalic, acrocephalic, scaphocephalic, plagiocephalic, etc. The results of pathological synostoses of the bones of the face in intrauterine life are seen in Crouzon's disease, or hereditary craniofacial dysostosis, and in a similar form associated with chronic hydrocephalus.

The author thinks the exophthalmos seen in anomalies of the skull is caused for the most part by decreased development of the orbital part of the frontal bone, and only to a negligible degree by lordosis of the base. This is in contradiction to the commonly accepted opinion but the author bases it on the fact that he has seen a case of slight oxycephaly with serious lordosis of the base without exophthalmos and other cases of oxycephaly and acrocephaly with exophthalmos without lordosis of the base. He thinks the exophthalmos in anomalies of the face is caused by changes in development of the bones forming the cavity of the orbit brought about by pathological synostoses of the middle tract of the spheno-frontal suture and probably of other sutures of the face. He thinks that increased distance between the eye and divergence of the axes of the orbital cavities, which together with reduction in the depth of the orbit itself, bring about exaggerated exophthalmos and divergent strabismus, are caused by an ethmoid the shape of a truncated cone with the larger base forward. This is due to pathological synostosis of the spheno-frontal suture and the compensatory force which tends to exaggerate this effect.

All the theories proposed heretofore to explain pathologically premature synostosis of the sutures, such as infection, trauma, hereditary disease, amniotic changes, etc., are one-sided, as none of them are found in more than a limited number of cases. The author believes that the fundamental cause is an endocrine disequilibrium, probably of the thyroid, and that the causes mentioned above are only exciting factors.—*Ludrey G. Morgan.*

CONTE, ETTORE. Intorno ad un caso di tumore del nervo acustico. (A case of tumor of the acoustic nerve.) *Radiol. med.*, Feb., 1933, *20*, 121–137.

The roentgen findings in a case of tumor of the auditory nerve are described in detail. The latero-lateral projection showed marked diastasis of the sutures, only slight digital impressions and marked enlargement and deepening of the sella turcica. The floor of the sella and that of the sphenoid sinus were almost on the same plane. The quadrilateral lamina was atrophied, most markedly so toward its free margin. There was neither prolapse nor retroversion of the lamina itself. The transorbital fronto-occipital projection showed digital impressions and Pacchionian granulations symmetrical to the longitudinal suture. The apex of the left petrous bone showed marked atrophy and there was a small area of erosion at the apex of the right pyramid. The frontal-suboccipital projection showed very distinctly the lesions of the posterior surface and upper margin of the left pyramid which appeared to be extensively eroded all around the internal auditory meatus. The mento-vertical projection also showed this picture on the left while the auditory meatus on the right appeared normal except for some dilatation.

These classical projections very clearly indicated that the tumor was on the left, but a Stenvers oblique projection showed a large round area of rarefaction around the meatus on both sides, with atrophy of the apex of the pyramid. Operation showed a very large tumor of the left auditory nerve. The patient died while being taken from the operating room. Careful post-mortem examination showed that the lesions of the right pyramid were on the anterior slope toward the middle fossa. They were evidently caused by long-continued compression of the venous sinuses and carotid by the hydrops of the third ventricle resulting from obstruction of the aqueduct of Sylvius by the tumor. This shows the importance of internal hydrocephalus not only in producing indirect general roentgen signs but also in causing lesions of the apex of the petrous bone.

Mayer thinks Stenvers' projection is the best one for the demonstration of such tumors but in this case the findings by this projection were confusing. Mayer also rejects the transorbital projection saying that in it the two carotid canals are superimposed. The author presents roentgenograms and diagrams to refute this claim and in examining the apices of the petrous bones he recommends taking transorbital roentgenograms of the two pyramids on the same film, centering first one orbit and then the other with a small localizer. The whole of the petrous bones can be shown in this way. He also says that in a submental-vertex projection properly carried out the internal auditory canal and the carotid foramen need not be confused.—*Audrey G. Morgan.*

NECK AND CHEST

Haahti, H. G. Beobachtungen über einen Fall mit ausgedehnten intrapulmonalen lufthaltigen Hohlräumen.(A case of extensive intrapulmonary air-containing hollow spaces.) *Acta radiol.*, 1932, *13*, 620–638.

In a young man, aged nineteen, roentgen examination showed subpleural cavities containing air throughout the upper lobe, a great part of the middle lobe and the upper part of the lower lobe of the right lung. The clinical and roentgenological signs were very much like those of a pneumothorax. However, the transition from the clear area to the shadow of the lung was diffuse everywhere and the surface outline of the collapsed lung could not be demonstrated in any projection. This finding remained stationary. Differential diagnosis from pneumothorax was definitely established when a pneumothorax actually occurred as a result of a puncture performed for the purpose of determining intrathoracic pressure. Slightly negative pressure was found inside the cavity which was not changed at all by the aspiration of 750 c.c. air. Bronchography showed the bronchi corresponding to these parts of the lung intact with the exception of a small diverticulum in the region of the hilus. The cavities could not be filled through the bronchi. The author concludes that there was a valve-like closure between the spaces and the bronchi. He is unable to decide as to the nature and cause of the changes.—*Audrey G. Morgan.*

Knutsson, Folke. Zur Kenntnis der normalen Röntgenologie der pleura parietalis. (Normal roentgenology of the parietal pleura.) *Acta radiol.*, 1932, *13*, 638–677.

The companion shadow of the second rib has been known since Albers-Schönberg's time. If it extended no farther than the second rib or in the lateral part of the thorax not farther than to the third and fourth it was not considered pathological, but similar companion shadows in any other region were considered signs of pleurisy. The author has found that on the posterior wall of the thorax the ribs are covered with musculature and that this produces a narrow soft-tissue shadow along the inside of the wall of the thorax. He suggests the name "inner muscle shadow of the chest wall" for this shadow. In the lateral part of the wall the muscular lining of the inner surface of the ribs disappears, leaving this and the anterior portion of the inner rib surfaces bare. Therefore the inner muscle shadow of the chest wall only appears when the subject is turned in such a way that the posterior parts of the thoracic wall are struck tangentially by the rays. It can then be followed downward as far as one of the lowest intercostal spaces where it disappears. In contrast with a pleuritic companion shadow, it does not cause any change in the sinus.

The density and extent of the normal inner chest wall shadow varies with the degree of muscle development in the individual. To avoid interpreting this inner muscle shadow of the chest wall mistakenly as a sign of pathological change it is necessary to know the possible limits of its extent. A diagnosis of lamellar pleurisy is justified only if an inner chest wall

shadow is found beyond those limits or if there is some asymmetry in the extent or density of the shadow. The muscle shadow is symmetrical.

The author calls attention to the fact that both in the normal muscle shadow and in case of pleural thickening the marginal zone as a rule appears denser than the rest of the shadow; he thinks this is due to an optical illusion and disagrees absolutely with Schönfeld who thinks it is pathognomonic of pleurisy. There are only exceptional cases in which there may be an anatomical basis for this greater density of the marginal zone; namely, when there is a tendinous intrathoracic fascia or there are fibrinous deposits or indurations with a denser consistency at the surface.—Audrey G. Morgan.

Gerin, Cesare. Le calcificazioni delle cartilagini costali negli individui normali e negl individui affetti da tubercolosi polmonare. (Calcification of the costal cartilages in normal individuals and individuals with pulmonary tuberculosis.) *Radiol. med.*, April, 1933, *20*, 514–540.

The author made more than 600 roentgenograms of individuals with normal thoraces and 700 of individuals with pulmonary tuberculosis. He studied the arrangement, structure and opacity of the calcifications of the cartilages in both sexes and at all ages. He also studied other shadows which might be confused with such calcifications, such as accessory epiphyseal centers of ossification of the sternum.

He concludes from his examinations that there is no relation between early calcification of the first costal cartilage and specific processes in the apex of the lung. There were more calcified costal cartilages in non-tuberculous than in tuberculous individuals.—*Audrey G. Morgan.*

Reichle, H. S. Resolving exudates in pulmonary tuberculosis of childhood. Study I. *Am. J. Dis. Child.*, Feb., 1933, *45*, 307–330.

Author's summary. The frequency and prognostic importance of the resolving lesions in pulmonary tuberculosis of childhood have aroused the interest of many workers. Questions bearing on their etiology, pathogenesis, histologic characteristics and clinical diagnostic criteria are, however, still unsettled.

On the basis of a critical review of the literature and in the light of personal clinical and pathologic experience, the conclusion is reached that these lesions are of three types: (1) simple atelectases, (2) non-tuberculous lobar or bronchopneumonias and (3) retrogressive tuberculous pneumonias. The exact relative incidence of the three lesions is not known, but it is probable that the retrogressive tuberculous pneumonias predominate. This is without doubt true for the lesions of long duration that lead to resolution. Since resolution is possible in almost every form of tuberculous inflammation, there is no reason for calling on any unusual mechanism to explain the retrogressive tuberculous exudates.

Clinically, the only reliable criterion for the diagnosis of the retrogressive type of tuberculous pneumonias is the course of the disease. This involves the ultimate complete or almost complete resolution of the process. The autopsies hitherto reported have dealt with the stage prior to possible resolution, or after resolution was complete, and therefore have contributed little to the solution of this problem. A decisive contribution would be made by repeated biopsy examinations, as in the case of Rubinstein.

In another contribution, clinical, roentgenographic and pathologic records will be presented which, it is believed, are in conformity with the ideas developed in this presentation.—*R. S. Bromer.*

Gasul, Benjamin M., and Singer, Harry A. Spontaneous pneumothorax in the newborn. *Am. J. Dis. Child.*, May, 1933, *45*, 1050–1055.

The authors report a case of spontaneous pneumothorax in the new-born because of the rarity of the condition and because of the nature of the causative condition. From the available evidence it seems likely that shortly after delivery the child aspirated some contaminated foreign material. This may have been in the form of saliva introduced through a catheter used by the obstetrician in clearing the infant's upper respiratory passages. The location of the lesion, at the apex of the right upper lobe would favor such a hypothesis. The pneumonitis with its overlying pleurisy would explain the slight embarrassment to respiration and irritability that were noted from the time of birth until the acute symptoms supervened. The focus of pneumonitis instead of resolving went on until abscess formation occurred. The abscess subsequently ruptured through the pleura, and

thereby produced a communication between the lung and the thoracic cavity. The occurrence of a pneumothorax was associated with the onset of dyspnea and tachypnea. The subsequent development of fever and a serofibrinopurulent exudate was obviously due to the presence of viable organisms in the exudate that escaped from the ruptured abscess. Judging from their nature, the histologic changes were of the same age as the child, namely, three weeks.

A review of the literature is also given and roentgenograms showing the pneumothorax are reproduced.—*R. S. Bromer.*

Pollock, William C., and Marvin, Horace P. Congenital cystic disease of the lung. *Am. Rev. Tuberc.*, Jan., 1933, *27*, 59–66.

Congenital cystic disease of the lung is a definite clinical entity and one of extremely rare occurrence. The authors report a case as yet in a state of excellent health. The condition is secondary to a congenital narrowing of the main bronchus or bronchi of the involved lobe or lobes. The cystic changes are usually stationary, but may progress under certain conditions. Extensive changes may be present without symptoms and the condition is usually accidentally discovered at routine roentgen examination. The lesion is not to be confused with congenital bronchiectasis since there are no dilatations of the bronchi. It is usually diagnosed as spontaneous pneumothorax but can be differentiated from this condition by careful consideration of the clinical picture and detailed roentgenographic interpretation. The induction of artificial pneumothorax serves as a positive differential diagnostic aid whereby a line of visceral pleura traversing the apparent structureless space is demonstrated. Bronchoscopic examination should be carried out in all cases to eliminate the possibility of partial obstruction from a foreign body or tumor mass. —*W. R. Brooksher.*

Kohn, Jerome L., and Koiransky, Henry. Relation of measles and tuberculosis in young children; a clinical and roentgenographic study. *Am. J. Dis. Child.*, Dec., 1932, *44*, 1187–1210.

This paper is a study of the effect of measles on the pulmonary system of 20 children between the ages of ten months and seven years, known to be affected with tuberculosis. Clinical and roentgenographic methods were used, before, during and after measles. The cases were followed for a period of from two weeks to twenty-two months. Until recent years measles was always considered a menace to a tuberculous child, and was thought frequently to reactivate an apparently quiescent tuberculous process At present, there are several observers who believe that measles is not as harmful as it was previously supposed.

This study is based on the examination of 20 children who were admitted to the Willard Parker Hospital because of measles. In all, 172 roentgenograms were studied. In 15 children, roentgenograms were taken before measles was contracted. In 17 children, roentgenograms were taken during the measles and in 17 cases after the measles had subsided.

The clinical course and the roentgenographic changes in the pulmonary system during and after measles varied. In accordance with these findings the cases were divided into six groups: I. Cases in which, previous to or at the onset of the measles, there had been a small area of pulmonary infiltration plus involvement of the mediastinal lymph nodes. During the measles the infiltration became larger and continued to progress until a large portion of the lung had become involved and death ensued. II. Cases in which, previous to the measles, there had been perhaps a small area of pulmonary infiltration plus involvement of the mediastinal lymph nodes. During the measles, instead of enlargement of this infiltration, scattered pulmonary opacities were seen in one or both lungs. As the patients improved, the physical signs gradually receded. Knowing that the children had been infected with tuberculosis before the measles, one was at first tempted to interpret all the infiltrations as tuberculous. However, most of the infiltrations cleared up in a comparatively short time. One or two years later, calcified hilar areas were seen. III. There was one case in which, previous to the measles, there had been a small area of pulmonary infiltration. Soon after the measles, a large homogeneous shadow was seen in the right upper lobe which persisted for a long time with little temperature reaction and few abnormal signs. The child did well after discharge. IV. There were 2 cases which during measles showed an additional hazy area of infiltration surrounding the site of the pulmonary infiltration of a so-called primary pulmonary tuberculous com-

plex. From this area strands radiated toward the hilar region. The hazy area entirely disappeared within a few weeks. v. Four cases in which in addition to scattered areas of pulmonary infiltration, a pleural effusion developed during or soon after the measles. This was usually a serous effusion from which no organism could be cultivated. vi. Cases, that previous to or during measles, showed very little pulmonary infiltration. On lateral exposure, however, enlargement of the lymphatics of the posterior mediastinum and of those localized at the bifurcation of the bronchi could be seen. After the measles, these children recovered rapidly and the size of the hilar shadows decreased.

Six fatal cases were autopsied and in 5 the authors believe the measles hastened the spread of the tuberculosis. Five of these patients were negroes. While the importance of the interpretations of roentgenograms is conceded by the authors, they believe that one must not draw too rigid conclusions from the roentgenographic evidence alone.

In this study, in addition to the anteroposterior position, roentgenograms were made in the right and left lateral planes and also in the oblique planes. The article is illustrated with roentgenograms to show the various groups mentioned above.

The authors conclude that while they cannot definitely state the effect of measles on tuberculosis, they feel that in young children, judging from clinical, roentgenographic and pathologic findings, measles contributes in many cases to the spread of the tuberculous process.—*R. S. Bromer.*

Sweany, Henry C. Studies on the pathogenesis of primary tuberculous infection. I. The regressive lesions. *Am. Rev. Tuberc.*, June, 1933, *27*, 559–574.

The regressive tuberculous processes, calcification, ossification, and resorption, are discussed and the findings from the examination of 188 pairs of lungs obtained at necropsy, roentgenographed and sectioned by a special method, are detailed. Of 88 specimens of characteristic primary lesions, 76 were in the parenchyma and 65 in the lymph nodes; 23 were located only in the parenchyma and 11 only in the lymph nodes. Bone was found in 22 of 84 calcified parenchymal lesions, in 23 of 97 lymph nodes, demonstrating no practical difference in bone formation between the local and the lymphatic lesion. Ante-mortem roentgenograms revealed about one-half of the calcified parenchymal lesions.—*W. R. Brooksher.*

Sweany, Henry C. Studies on the pathogenesis of primary tuberculous infection. II. Tendencies in adult primary tuberculous infection. *Am. Rev. Tuberc.*, June, 1933, *27*, 575–588.

Six primary-like infections in adults are reported, which differ from the usual type in that the lymph-node complex was very slight or entirely absent. This type of adult infection closely resembles a primary lesion and, while most probably primary in character, has the frequent lack of a lymphatic and systemic spread. The variation in this lesion is so constant among adults, living under civilized conditions, that it may be questioned if it is not the usual course in these individuals. The theories which serve to explain the material difference between childhood and adult infection are discussed. Sweany suggests an outline for a classification of these primary infections in which the "stages" of the Ranke theory are considered as phases. The primary lesions would thereby be divided into three phases: the local or parenchymal phase, the lymphatic phase and the hematogenous phase. These would then be further subdivided into various types or degrees. The first type would represent the clear-cut group, minimal in extent, limited in its course and definite in its outcome. The second type may be minimal or moderate in quantity, but exhibits no limitation in extent or outcome. The third type represents those large first infections with a progressive course, rarely showing regression.—*W. R. Brooksher.*

Myers, J. Arthur. Types of tuberculous lesions found in the chests of students of nursing and medicine. *Am. Rev. Tuberc.*, July, 1933, *28*, 93–117.

Myers is convinced that the young adult who has been protected against tubercle bacilli and first becomes infected in adult life is in no greater danger of developing a rapidly destructive type of lesion than the child; and further, that so-called childhood infection is not necessary to protect the adult against destructive and fatal tuberculosis, but is always the forerunner of this disease. The necessity for careful observation of students of nursing and medi-

cine is emphasized and the etiological factor of exposure under working conditions lacking in medical asepsis is fully discussed. The methods employed at the University of Minnesota for such observation are detailed. The positive tuberculin reaction is considered the first manifestation of invasion by tubercle bacilli, preceding roentgen findings by weeks and months, and is the sole evidence of tubercle formation in many cases.—*W. R. Brooksher.*

Wessler, H., and Hennell, Herman. Benign pulmonary tuberculosis with diabetes. *Am. Rev. Tuberc.*, Jan., 1933, *27*, 47–58.

From the observations on a number of cases of tuberculosis in diabetics, the authors conclude that, while the coexistence of diabetes is not a matter of indifference to the progress of the tuberculosis, the disease in the diabetic is not inherently or necessarily progressive or fatal, but may, on the other hand, be a benign and curable infection. The tuberculous lesions found in their cases were always exudative in nature and exhibited the usual character of the disease as found among the general population. No tendency to progression was manifested in any case, but, on the contrary, with proper dietetic care under ordinary hospital conditions, the pulmonary infiltration rapidly absorbed, and, in most of the cases, went on to complete cure in a relatively short time. Most of the patients had had diabetes for a number of years and showed a low sugar tolerance.—*W. R. Brooksher.*

Oechsli, Waldo R., and Skillen, Jane. Spontaneous pneumothorax with acute abdominal symptoms. *Am. Rev. Tuberc.*, Jan., 1933, *27*, 67–70.

No difficulty is encountered in the diagnosis of spontaneous pneumothorax in the patient presenting typical symptoms, but occasionally the character of the symptoms leads one to suspect some extrapulmonary condition. Dyspnea is undoubtedly the most constant symptom. A case is presented in which the predominating symptoms were gastrointestinal and dyspnea was practically absent. The variation from the usual symptom-complex is probably explained by the fact that the direction of greatest displacement of viscera was downward, consequently embarrassing the diaphragm.—*W. R. Brooksher.*

Hetherington, H. W., and Flahiff, E. W. Fluoroscopy in tuberculosis case-finding. *Am. Rev. Tuberc.*, Jan., 1933, *27*, 71–80.

Roentgenograms reveal the type, anatomical extent and characteristics of latent tuberculosis of the lung and tracheobronchial lymph nodes, but the routine application to all school-children to find those threatened with the development of clinical tuberculosis has the one objection of cost. Various methods of discovering, at the least possible cost, the largest possible number of children who, on further examination, will be found to have significant lesions, have been adopted or proposed. The cheapness of roentgenoscopy recommends it when examinations at frequent intervals are required but the superiority of roentgenography over this method is generally granted. The present study compares the results of the examination of 347 young adults with the roentgenoscope and with stereoscopic roentgenograms. The roentgenoscopic examination was most disappointing in its failure to detect small and scanty apical involvement, that is, apical tuberculosis limited to the lung above the clavicle. Furthermore, when one shoulder is lower than the other and the ribs on one side are closer together, the resulting impairment of illumination may cause apical disease to be suspected where it does not exist. Roentgenoscopic observation of the lungs of young adults and adolescents will demonstrate only a part of the tuberculous disease as revealed by the roentgenogram. However, the cases detected by roentgenoscopic examination are likely to be the more advanced and significant instances of the disease, which more urgently require treatment or supervision. Of 367 children reacting to tuberculin, lesions were found by roentgenograms in 108, or 29.7 per cent, and of 69 children in whom the disease was suspected after roentgenoscopic examination, in 43, or 62.3 per cent. This is evidence that more children will be found to have significant lesions among those selected for roentgenographic examination with the roentgenoscope than among those selected by the tuberculin reaction.—*W. R. Brooksher.*

Dubrow, James L. The roentgenological appearance of pulmonary atelectasis and simulating conditions. *Am. Rev. Tuberc.*, Oct., 1932, *26*, 408–417.

The roentgenological appearances generally considered typical of pulmonary atelectasis, a

homogeneous dense shadow, obliterating the parenchymal markings and associated with a retraction of the heart and trachea to the same side, combined with an elevation of the homolateral dome of the diaphragm, are not necessarily pathognomonic of this condition. Such a shadow is not infrequently produced by croupous pneumonia of an entire lung, unilateral pulmonary tuberculosis with tendency to fibrosis and pleural thickening, and unilateral pleural effusion in association with a fixed mediastinum and certain therapeutic procedures, as the use of gomenol in oleothorax. Pleural puncture may prove valuable in the differentiation, yielding fluid in cases with effusion, high manometric readings with atelectasis and no readings with thickened pleura.—*W. R. Brooksher.*

Sokol, Louis I. Massive atelectasis complicating pulmonary tuberculosis. *Am. Rev. Tuberc.* Oct., 1932, *26*, 442–461.

Massive atelectasis is comprehensively reviewed and 2 cases in which the condition occurred as a complication of pulmonary tuberculosis are presented. The lesion is defined as an acute or subacute febrile complication, produced by the obstruction of a bronchus, and followed by a more or less complete absorption of vesicular air in the corresponding portion of the lung, thus giving the organ a structure resembling fetal lung. It is characterized by the clinical symptons of unilateral pulmonary consolidation with displacement of the mediastinum and its contents toward the affected side. The intrabronchial, extrabronchial and idiopathic causes are discussed. The striking symptoms are not sufficiently characteristic to establish a diagnosis without the confirming aid of the roentgen examination. The roentgen appearance depends upon the extent of the collapse and, to some degree, on the etiological factors involved. The principal conditions from which it must be differentiated are pneumonia, spontaneous collapse, pleurisy with effusion, as well as acute dilatation of the heart, infarction diaphragmatic hernia, pulmonary embolus and thrombosis. Artificial pneumothorax has proved to be one of the main treatments of choice.—*W. R. Brooksher.*

Coryllos, Pol. N. The importance of atelectasis in pulmonary tuberculosis. *Am. Rev. Tuberc.*, July, 1933, *28*, 1–26.

Atelectasis is an almost constant phase in the evolution of tuberculosis and an important factor in its development. The influence on the course of tuberculosis by the development of fibrous tissue may actually be due to atelectasis. In this study emphasis has been placed upon the gas-exchange function of the lungs rather than on the pathological changes in pulmonary tissue. The bronchial changes occurring in tuberculosis and the bronchial obstruction syndrome are discussed. The author believes that when complete bronchial obstruction is produced by these bronchial lesions, there is absorption of air within that part of the lung served by the obstructed bronchus, and thus an atelectasis occurs. Atelectasis may be similarly produced by bronchial compression from hypertrophied tracheobronchial and bronchopulmonary tuberculous lumph nodes. Bronchial stenosis may be followed by emphysema rather than by atelectasis, as when there is a valve-like mechanism, allowing more ready ingress of air during inspiration than egress of air during expiration. Fibrous tissue formation in tuberculous lungs is more evident in atelectatic areas, a fact that the author feels is due to decreased pulmonary ventilation and ischemia. The theory is advanced that tuberculous air-containing cavities close and collapse only when their outside connection, the bronchus, is not patent. For this, the author believes that an "airless" lung, or atelectatic lung, is essential in addition to compression from pneumothorax or thoracoplasty. This theory explains spontaneous obliteration of cavities as being due to spontaneous closure of the bronchial outlets of the cavities and it further suggests that a rational method of treating tuberculous cavities would be by some procedure which would close their "connecting bronchi." The author's hypothesis of the mechanism of the cure of tuberculous cavities following successful collapse states that collapse of the diseased lung produces closure of the communication between the cavity and outside air; under these conditions the gaseous content is absorbed according to the laws of gas-exchange in the lung. A condition of anoxemia is produced in the cavity, further enhanced by the absorption of oxygen by the avascular tissues of the cavity. That such a degree of anoxemia is possible in pulmonary tissue is shown by putrid abscesses of the lung. In these, under similar conditions of obstructive atelectasis, a degree of anoxemia is developed sufficient to allow the development of strict anaerobes. The respiratory mech-

anism of the tubercle bacillus is so greatly affected by this lack of oxygen that it will fall rapidly to zero. It has been experimentally shown that the anaerobiosis produces impairment of the vitality and, if prolonged, arrests the growth and causes definite injury to these organisms, as demonstrated by recultivation. Furthermore, the closure of the outlet of the cavities checks the exit of the bacilli and thus prevents further dissemination and spread of the infection.—*W. R. Brooksher.*

Myers, J. A. Progress in the diagnosis of tuberculosis, with special reference to the x-rays. *J. Am. M. Ass.*, June 24, 1933, *100*, 2004–2006.

Careful observation and study in the field of tuberculosis has eliminated all but a few minor controversial questions. The tuberculin test and the roentgen examination are now considered necessary steps in every satisfactory examination. The rapidity and lessened expense of paper films in chest roentgenography is important in public health work. Although the same clarity of detail is not obtained as with the celluloid film, it is not felt that there is any appreciable handicap in practical diagnosis. The method is highly satisfactory for case-finding work and in serial studies. In private practice the difference in the cost of paper and celluloid films is an insignificant part of the charge to each individual patient since the major portion of the fee is based upon the ability of the physician to interpret the shadows. In any survey the public should be advised that the interpretation of the films is, for the most part, an act of charity by the physicians. The paper film method deserves the support of the medical profession because it offers cheapness, makes roentgen examinations possible for a large number of persons who otherwise would not have them and has real merit as a diagnostic procedure.—*W. R. Brooksher.*

Balestra, Giovanni. Sul limite di visibilita dei focolai broncopolmonari. (Limits of visibility of broncho-pneumonic foci.) *Radiol. med.*, Jan., 1933, *20*, 32–48.

The author studied the best methods of roentgen examination of pulmonary foci by means of applying small squares of aluminum to the walls of the thorax and photographing them under different conditions. He found that much greater visibility of intrapulmonary foci can be obtained by working out the best technique. It is best to use rays of moderate hardness, too soft rays being preferable to too hard ones. A voltage of from 50 to 70 or 80 kw. has been found best. Visibility is affected by both the size and thickness of the bits of aluminum used. Blocks of less than 1.05 mm. in thickness were not visible and larger blocks were more clearly visible than smaller ones, particularly if they were very thin. A distance of 2 meters from the focus to the film gives the clearest pictures. The degree to which the shadows are obscured by the ribs depends on whether they lie under the spongy part of the rib or the compact edges. The superposition of spongy bone does not increase visibility as some authors have claimed. Shadows over a pneumothorax show up much more clearly than those over normal lung tissue.

Shadows below the apex are most clearly visible, while those at the base, the apex and those lying within the median shadow are less clearly visible. The exposure time should be very short, about one-tenth of a second. A first roentgenogram should be taken in the dorsoventral direction and a second in the ventrodorsal; the latter avoids superpositions and helps to differentiate between normal and pathological shadows.

The author believes that actual anatomical lesions are more readily visible than the aluminum plates as there are reaction zones around them that increase their size and density.—*—Audrey G. Morgan.*

Fiorenzi, Oliviero. Sulla esporazione radiologica dell' apice polmonare. (Roentgen examination of the apex of the lung.) *Radiol. med.*, April, 1933, *20*, 460–492.

There has been an active discussion as to whether adult tuberculosis originates from reinfections in the apex or from Assmann foci. Pathological anatomists find many apical foci while roentgen examination does not show them. The author believes that the contributions made to the subject heretofore from the standpoint of roentgenology have little value because the technique used has been too imperfect.

He thinks the term apex as commonly used is not sufficiently definite. He defines the apex as the part of the lung situated above a horizontal plane at the level of the first costal cartilage and divides into three parts, the vertex, the culmen and the remainder of the apex. The vertex is the extrathoracic part which projects above the ring formed by the first rib. The culmen is the

intrathoracic part coinciding with the highest geometrical point in the lung in situ; this is not, as would seem at first glance, the vertex. The culmen is located beneath the joint head of the vertebra or beneath the tuberosity of the first rib. The culmen is the region of distribution of the apical bronchus and according to Loeschke and Zeiss contains 96 per cent of all foci of reinfection.

He examines the anatomical obstacles to the demonstration of the first intercostal space and concludes that the best projections for this purpose are those of Levy-Dorn and Cornet, later adopted by Busi, and a posterior oblique caudocranial projection which he himself has devised. He shows that the culmen can be demonstrated with this caudo-cranial projection. He discusses the significance of the satellite shadow of the first rib seen in roentgenograms obtained by the projections of Levy-Dorn and Cornet and agrees with Albers-Schönberg and Danelius that it is physiological and marks the upper boundary of the apex of the lung. He reviews some physiological causes which may increase the size of the satellite shadow and simulate pathological conditions. He believes that by the use of the above-mentioned projections valuable data can be collected which will help to clear up the question of the beginning of tuberculosis and establish the significance of apical reinfections.—*Audrey G. Morgan.*

FAULKNER, WILLIAM B., JR., and FAULKNER, E. C. Post-operative massive collapse of the lung. *Northwest. Med.*, 1933, *22*, 87–92.

In the authors' experience, atelectasis has been the result of excess tracheobronchial secretion and exudate, acting as an intrabronchial foreign body or to cause infection of the bronchial mucous membrane, the resultant edema obstructing the flow of air to a portion of the lung. This secretion is already present within the tracheobronchial tree in patients with suppurative lung conditions, while in others who have had no previous pulmonary disease, it is aspirated from the mouth and nasopharynx during or immediately following the operative procedure. The secretion spills, in either event, to the most dependent and accessible regions within the lung, plugging the bronchi and setting up infection. The condition may be avoided as a postoperative complication by adopting measures to lessen the chances of aspiration. Patients with pulmonary abscess should have bronchoscopy before and after operation in addition to postural drainage. The preoperative administration of atropine, the slow induction of anesthesia, oral toilet and oral nasopharyngeal suction, may be advantageously employed. Treatment should be directed along the same general lines as for prevention, but the essential point is early recognition.—*W. R. Brooksher.*

MEAKINS, J. C., and MACLEOD, J. W. Carcinoma of the bronchi. *Canad. M. Ass. J.*, March, 1933, *28*, 268–275.

Bronchial carcinoma is comprehensively discussed. Unaided roentgenography is practically of no value in the early case, i.e., before there is involvement of the peribronchial or mediastinal lymph glands or invasion of pulmonary tissue. Contrast media bronchography with iodized oil is of value in demonstrating narrowing or obstruction of the bronchi, the usual accompaniment of tumor. The bronchoscope offers the most perfect means for detection of these neoplasms, and, in addition, permits removal of tissue for histological study. For the differentiation of a massive lesion, either neoplastic or inflammatory, artificial pneumothorax will be an aid; but is of little value if there has been no invasion of the pulmonary tissue by the neoplasm. Secondary bronchial lesions, practically always the result of obstruction, leading to atelectasis and bronchiectasis, are comparatively easy of recognition, but may confuse the diagnosis. The presence of either of these conditions in a single lobe without a definite history of a pulmonary lesion should suggest the possibility of neoplasm. The metastatic lesions usually begin as a local process, extending to form a massive pulmonary consolidation. In the early cases, modern lung surgery may effect a complete cure.—*W. R. Brooksher.*

COOKE, JEAN V. Mediastinal tumor in acute leukemia; a clinical and roentgenologic study. *Am. J. Dis. Child.*, Dec., 1932, *44*, 1153–1177.

The purpose of this paper is to report a group of 9 cases of acute leucemia with large mediastinal tumor or infiltrations, and the result of roentgen therapy on this condition. Localized tumor masses composed of round sarcoma-like cells have at times been observed at necropsy in patients dying of acute leucemia. These have been noted most frequently in the anterior me-

diastinum and have usually been considered of thymic origin, but have occurred less often in other locations, as for instance in the subcutaneous tissues, skin, bone and serous membranes. Of these 9 patients with mediastinal tumors all were white boys between the ages of three and eleven years; the blood picture of each was typical of acute lymphatic leucemia, with a tremendous preponderance of nongranular mononuclear cells and a small percentage of granular polymorphonuclears. Only one child had no leucocytosis, although several had "aleukemic" phases while under observation. Four came to observation before any changes in the blood were demonstrable, and had symptoms of respiratory obstruction. The remaining 5 had typical leucemic changes when first seen. In the 4 with respiratory symptoms, roentgen therapy produced marked relief from the respiratory distress. In 3 the mediastinal tumor disappeared completely after irradiation within a few days, the disappearance persisting until the death of the patients.

It seems likely that such mediastinal involvement is more frequent in acute leucemia than is generally recognized, since the 9 instances reported occurred in a series of 38 cases. A review of the cases of 83 patients including those of this report, shows that the condition affects males almost six times as frequently as females, and that over 90 per cent have occurred in persons under thirty years of age.

Although irradiation has usually produced a temporary beneficial effect on the mediastinal tumor, if employed before blood changes were present, such irradiation by roentgen rays or radium afterward seems not only to be without benefit, but in certain instances to have hastened the time of death. The study of the clinical and the pathological reports of the observed cases has given the impression that the mediastinal mass is the result of infiltration by leucemic cells carried there by the blood stream rather than a true neoplastic tumor arising in situ. Whatever its nature, the condition is sufficiently characteristic, as determined by modern methods of clinical examination, to be readily recognized and to merit consideration as a clinical entity in acute leucemia. The data presented indicate that its occurrence is more common than is usually appreciated.

Roentgenograms illustrating the effect of irradiation upon the mediastinal tumors are reproduced but the technique of the roentgen therapy is not given in detail.—*R. S. Bromer.*

Timpano, Mario. Ernie mediastiniche anteriori superiori in pneumotorace terapeutico. (Anterior-superior mediastinal hernias in therapeutic pneumothorax.) *Radiol. med.*, Dec., 1932, *19*, 1317–1338.

Four cases of anterior-superior mediastinal hernia occurring in the course of therapeutic pneumothorax are described and illustrated with roentgenograms. In 3 of the cases the pneumothorax had been unilateral and in one bilateral.

Mediastinal hernia is rare and tends to become rarer as the technique of pneumothorax improves and closer watch is kept of the cases by means of roentgenoscopic examination. There are two points at which the mediastinum is apt to yield: the first is at the site of the thymus where in the adult the two folds of the pleura are almost in contact on account of the atrophy of the gland. This gives rise to anterior-superior hernia. All of these 4 cases were of this type. It generally occurs in young adults; it is prevented in young children by the presence of the thymus. The other is in the posterior-inferior segment of the mediastinum between the aorta and the esophagus.

Probably the most important factor in producing mediastinal hernia is a decidedly positive pressure on the side of the pneumothorax. An attack of coughing or a sudden movement which raises the pressure may be the immediate cause of a hernia. A very low negative pressure on the opposite side may also be a contributing factor, as well as inflammation of the pleura. A hernia may take place in either a fixed or a mobile mediastinum.

Roentgen examination is of great importance in the diagnosis of mediastinal hernia, particularly in small ones which often cause no objective symptoms and are very hard to detect by physical examination. The oblique and transverse projections are of special value in determining the outline and size of the sac, observing its relations to the adjacent organs and fixing the point at which the mediastinum has yielded.

If a mediastinal hernia is causing serious symptoms the pneumothorax air may be withdrawn. If it is not, the air should not be withdrawn as it may reawaken the tuberculous focus. Most of these hernias do no serious harm and the pneumothorax treatment was con-

tinued in 3 of the author's cases, the pressure being slightly reduced in one of them. One of the patients died of the tuberculosis. These patients should be carefully followed up by roentgen examination and manometric control throughout the treatment.—*Audrey G. Morgan.*

KETTERER, CLARENCE H. Spontaneous pneumothorax with aortic aneurysm and pulmonary fibrosis. *Am. Rev. Tuberc.*, June, 1933, *27*, 553–558.

The author presents a case of spontaneous pneumothorax, which was thought to be due to pneumoconiosis and in which there was an incidental aortic aneurysm. The differential diagnosis of pulmonary fibrosis, tuberculosis and syphilis is discussed. In this case, pulmonary tuberculosis was ruled out clinically and by laboratory tests, but syphilis cannot be positively denied although there was no appreciable effect on the pulmonary fibrosis after five months of antiluetic therapy.—*W. R. Brooksher.*

KERLEY, P. Congenital diseases of the heart. *Brit. J. Radiol.*, May, 1933, *6*, 257–265.

Roentgenology can never be more than supplementary aid to clinical and electrocardiographic methods in the study of heart disease. Aneurysm and coarctation of the aorta are the exceptions. The difficulty of exact diagnosis in congenital lesions of the heart is multiplied many times from the fact that they are nearly always multiple in their occurrence. The author classifies the lesions in three main groups and discusses the subdivisions in each group. The main groups are: (1) cases in which there is no admixture of arterial and venous blood; (2) cases with an arterial venous shunt without cyanosis or with late cyanosis, and (3) cases with a venous arterial shunt and definite cyanosis. In the first group he places dextrocardia, idiopathic heart hypertrophy, bicuspid aortic valve, right-sided aorta, coaractation of the aorta and fetal endocarditis. Coarctation of the aorta is considered a fairly common congenital malformation. The condition always gives positive roentgen findings, even in mild cases with no symptoms. The roentgen appearances are described as a dilatation of the ascending part of the aorta and in the left anterior oblique view the defect can be seen with good technique. Even with poor technique it may be suspected, owing to the unusual clarity of the bifurcation of the trachea. The dilated intercostal arteries carrying on the collateral circulation produce characteristic indentations on the inferior rib margins. When the stricture of the aorta is severe, there is associated left ventricular hypertrophy—a roentgenologically visible feature. In group 2, patent ductus arteriosus, aortic septal defect, patent foramen ovale and patent interventricular septum are discussed. The roentgen signs of patent ductus arteriosus are enlargement of the pulmonary artery and of both ventricles. Two identical roentgenograms, taken in quiet inspiration and in forced expiration, will demonstrate a decrease in the shadow of the pulmonary artery during expiration. No roentgen record exists of a case of aortic septum defect but theoretically the appearances should be identical with those of patent ductus arteriosus. Patent interventricular septum presents roentgenologically a hypertrophy and rotation to the left of the left ventricle which is followed by the right ventricle, if large, displacing the apex upward. Synchronous pulsation of both heart borders is also observed, a sign most obvious with large defects before hypertrophy of the left ventricle develops. Group 3 considers pulmonary stenosis, cor trioculare, Eisenmenger's complex, Fallot's tetralogy and patent interventricular septum with pulmonary atresia or transposition of the arterial trunks. The roentgen signs of pulmonary stenosis are gross dilatation of the pulmonary artery distal to the stenosis, dilatation of the conus arteriosus, and enlargement of the right ventricle. The heart is very similar to the mitral heart but left auricular enlargement is absent. While no known roentgen records of a case of cor trioculare (absence of the interventricular septum) exist, such a case must present synchronous pulsation of both cardiac borders, enlargement of the right auricle and dilatation of the pulmonary artery. In Eisenmenger's complex, there is a defect at the top of the ventricular septum with the aorta displaced to the right, riding over the defect so that it receives blood from both ventricles. Enlargement of the right auricle, right ventricle and the pulmonary artery are noted. The aorta is invisible. Synchronous pulsation of both cardiac borders is not present due to the high position and small size of the ventricular defect. Fallot's tetralogy consists of pulmonary stenosis, ventricular septum defect, dextro-

position of the aorta and hypertrophy of the right ventricle. The roentgen appearances have been described by Bedford as a "coeur en sabot" heart outline with a cavity in the region of the pulmonary artery due to hypoplasia of the vessel, though the conus arteriosus at a lower level may be dilated. There is visible dextroposition or enlargement of the ascending aorta and the right ventricle pushes out to the left and displaces the apex upwards. Conditions simulating congenital heart disease on the roentgenogram are all lesions involving the pulmonary artery, mitral stenosis being the most common, then traction on the pulmonary artery by left upper lobe fibrosis and rarely, aneurysm of the pulmonary artery or rupture of an aortic aneurysm into the pulmonary artery.—*W. R. Brooksher.*

Cignolini, Pietro. Cuore e costituzione. (Heart and constitution.) *Radiol. med.*, Feb., 1933, *20*, 138–145.

The author points out the value of greater knowledge of constitutional types of heart and proposes a classification into nine varieties based on a morphological heart index and an index based on the proportion between heart volume and body volume. The morphological index is determined by multiplying the diameter of the base by 100 and dividing the result by the longitudinal diameter of the heart; hearts are divided into three types, depending on the value of this index: the normotype, the brachytype and the longitype. The index of development is determined by multiplying the transverse diameter of the thorax by the height of the individual and dividing the result by the surface of the heart. The hearts of the three types mentioned above are divided according to the value of this quotient into those of normal development, those of excessive development and those of deficient development.

Among 220 cases examined 38 per cent were of the normotype; of these 16 per cent were normal, 9 excessive and 13 deficient in development; 38 per cent were of the brachytype, 19 per cent normal, 8 per cent excessive and 11 per cent deficient; 24 per cent were of the longitype, among them 12 per cent normal, 8 per cent excessive and 4 per cent deficient. The total percentage of normal hearts was therefore 47 per cent, of excessive 25 per cent and of deficient 28 per cent.—*Audrey G. Morgan.*

ABDOMEN

Nielsen, Niels, and Christiansen, Harald. The passage of food through the human stomach. *Acta radiol.*, 1932, *13*, 678–685.

Experiments in observing the passage of food through the human stomach are described and illustrated with roentgen plates. They show that solid food does not become mixed but arranges itself in layers and on the whole is evacuated in the order in which it is ingested. Liquid food acts in the same way. Liquid food ingested on a full stomach does not become mixed with the solid food but sinks down into the sinus ventriculi—without following the sulcus salivalis, however—and begins to empty after a few minutes. This stratification explains why the action of ptyalin can continue for a longer time in the central part of the stomach contents which have not yet come in contact with the acid gastric juice. From the practical point of view, this stratification means that the stomach contents is not homogeneous, which must be taken into consideration in estimating the results obtained by removal of parts of such contents.—*Audrey G. Morgan.*

Overend, T. D. The relief study of the stomach and colon. *Brit. J. Radiol.*, May, 1933, *6*, 288–293.

The difficulties attending the study of digestive relief, as enumerated by Cole, are briefly mentioned and the author's apparatus for applying graduated compression is illustrated and described. Gastric relief appearances are due to the presence of folds in the mucosa and are classified as constant and as variable patterns. The conflicting opinions of Forssell, Berg and Chaoul are summarized. A reasonable attitude would be to concede to the muscularis mucosa a potential independence and, at the same time, to regard its activities as normally closely coordinated with the general functions of the stomach. Any deviation from the normal pattern may thus be considered as the response to an abnormal stimulus, which may be of quite a trifling nature, rather than a capricious activity of the muscularis mucosae. The relief changes occurring in chronic gastritis, chronic gastric ulcer and carcinoma are discussed. Colonic relief is not always easy of demonstration but its main features are the longitudinal folds interrupted at the haustra by transverse, curved or pointed folds. Diverticula can often

be more readily detected on relief than in the filled colon. Carcinoma of the colon causes an actual loss of relief markings. The full benefit of the relief study method only accrues when it is used in conjunction with the examination by filling.—*W. R. Brooksher.*

LÖNNERBLAD, L. Zwei Fälle von Mageninvagination. (Two cases of invagination of the stomach.) *Acta radiol.*, 1933, *14*, 82–94.

Two cases of invagination of the stomach are described and illustrated with roentgenograms. So far as the author knows they are the only cases that have been diagnosed by roentgen examination during life. The invagination in both cases was caused by tumor and the roentgen diagnosis was based on the following signs: straightening of the lesser curvature, shortening of the canalis, retention, enlargement of the duodenum by the invaginated tumor, unusual mucous membrane relief caused partly by the presence of the tumor, and in one of the cases a central, tunnel-shaped filling defect with axial stripes of contrast medium and surrounded by rings of contrast. In the other case, there was an oblique, ribbon-like filling defect running obliquely from the lesser curvature to the pylorus. Control examinations a few days later in both cases showed that the invagination had receded spontaneously.—*Audrey G. Morgan.*

GAVAZZENI, ANTONIO. L'Esame delle pliche mucosa nel carcinoma dello stomaco. (Examination of the mucous folds in carcinoma of the stomach.) *Radiol. med.*, March, 1933, *20*, 380–416.

An accurate knowledge of the normal and pathological relief of the mucosa of the stomach is one of the most valuable contributions to roentgenology in the last decade. The author reviews the history of the development of the method and describes the different techniques in use. There are two chief methods, one of which introduces a small amount of contrast medium and then distends the stomach, while in the other the examination is made with the walls collapsed. He himself prefers to use a very small amount of barium sulphate, less than that generally used, which shows the mucous membrane outline in more minute detail. The finely powdered barium sulphate is suspended in an equal amount of water. The suspension is given to the patient standing and by manual manipulation it is distributed over the walls of the stomach. With modern apparatus which permits of rapid transition from fluoroscopy to roentgenography records of the most characteristic findings can be made. The standing position is best for the body of the stomach, while the horizontal position is best for the antrum and cardia. When the examination in both positions is finished the stomach is filled with a Rieder meal and the usual examination made.

For though the new method gives much information in regard to detail the old method cannot be dispensed with and the problem of really early diagnosis of stomach cancer is by no means settled.

The normal and pathological findings by the new method of examining the mucous membrane folds are discussed and illustrated with roentgenograms. Great care must be exercised in interpreting the roentgenograms, for the picture of the mucous membrane folds is influenced by various factors, such as residues of food or mucus, foreign bodies in the stomach and defects due to pressure by organs or tumors outside the stomach. Sudden interruption of the folds is considered an early sigh of carcinoma but it may occur in benign processes or may even be simulated by the presence of gas or residues of food. If the contrast medium has not been properly distributed over the stomach wall there may also be interruptions in the folds. The halo surrounding an ulcer niche may simulate tumor. Large rigid digitiform folds are certainly a valuable indication of tumor and also indicate its extent and operability. But even these are not always pathognomonic. They must be rigid as well as large and if their form can be changed by palpation the finding is not conclusive. The neoplastic infiltration may extend beyond the folds also so that definite judgment as to the extent of the tumor cannot be based on this finding. Similar roentgenograms may also be seen in syphilis and tuberculosis of the stomach. The finding of a normal mucous membrane relief quite definitely excludes cancer.—*Audrey G. Morgan.*

ANZILOTTI, ALBERTO. Sull'immagine "ad anello" in gastro-duodenal ulcer. (The "ring" picture in gastroduodenal ulcer.) *Radiol. med.*, March, 1933, *20*, 292–303.

About two years ago Toscani described a special picture in 3 cases of gastroduodenal ulcer in which the roentgenograms were made by the ordinary technique without compression of

the bulb of the duodenum; he called it the ring sign because there was a found clear area in the center of the ulcer niche which must have been caused by something on the base of the ulcer.

The author describes a case in a man of thirty-three who came for treatment with signs of ulcer. The roentgenogram showed an elongated ring on the anterior wall of the bulb near the lower margin which was interpreted as a niche, particularly as duodenal peristalsis was arrested there. Operation showed an ulcer scar in the superior part of the duodenum and duodenocholecystic adhesions. A pyloroduodenal resection Billroth II was performed. When the operation specimen was opened a small ulcer was found exactly at the site of the ring in the roentgenogram. The base of the ulcer was clean.

The author concludes that the ring shadow was caused by a clot on the base of the ulcer which had been removed probably by the purgative given the day before operation. At any rate, there was no proliferating granulation tissue on the base of the ulcer which has been assumed to be the cause of the ring sign by some authors. Nor was there any ulcer wall or periulcerous edema to explain the ring.—*Audrey G. Morgan.*

Benassi, Enrico. Le ulcere gastro-duodenali doppie o multiple. (Double or multiple gastroduodenal ulcers.) *Radiol. med.*, April, 1933, *20*, 445–459.

The author believes that double or multiple ulcers of the digestive tract are much more frequent than has heretofore been believed and that with improvement in roentgenological methods and a minute examination of the whole digestive tract they will be demonstrated much more frequently and that the pathological and clinical picture of ulcer disease will be much more thoroughly understood. Autopsy often shows multiple ulcers where the surgeon has only found one. There are also both technical and subjective factors which make it difficult to demonstrate multiple ulcers roentgenologically.

Among about 900 cases of gastroduodenal ulcer he has found double or multiple ulcer in 65, and in 15 cases this finding has been confirmed by operation. He has found many more double ulcers since his attention has been called to the possibility of their existence and he believes that other roentgenologists will find this true if they supplement their ordinary roentgen examinations by serial roentgenograms and careful examination of the mucous membrane relief of the stomach and duodenum. The roentgen demonstration of multiple ulcers may be of great practical importance, particularly when the ulcers are in different organs or when they are at a distance from each other in the stomach or duodenum, for generally the clinical symptoms do not indicate multiplicity of the ulcers, and one or more of them may be overlooked in surgical treatment.

Twenty-seven cases of typical roentgenograms of multiple ulcer are given.—*Audrey G. Morgan.*

Howard, C. P. Linitis plastica. *Quart. J. Med.*, Jan., 1933, *2*, 59–78.

The author reports 10 cases personally observed, 8 of which were typical clinically, roentgenologically and histologically. Two others were acceptable on clinical and roentgenological grounds, but were not proved histologically. The history, pathogenesis, morbid anatomy, histology, symptomatology and diagnosis are fully discussed. He concludes in common with other students of the disease that it is impossible to maintain that any one uniform process is represented. The majority of cases are felt to belong to the malignant classification of the lesion, and the benigh type, while not denied, is thought not to have received a sufficiently careful histological study. Although syphilis may be an exciting factor, the majority of the so-called syphilitic leather-bottle stomachs have shown a secondary invasion by cancer cells. An exhaustive bibliography accompanies the article.—*W. R. Brooksher.*

Meyer, Karl A., and Singer, Harry A. Syphilis of the stomach, with special reference to its recognition at operation. *Arch. Surg.*, March, 1933, *26*, 443–464.

The recognition of syphilis of the stomach at operation is important for practical as well as for academic reasons. A granulomatous infiltrate sufficiently thick to be readily visible and palpable, most commonly is diagnosed carcinoma, entailing wide resection with its high mortality. On the other hand, syphilitic involvement requires no surgical procedure other than the removal of tissue for biopsy or gastroenterostomy in the presence of obstruction. With a relatively thin granulomatous infiltrate, syphilis can be easily overlooked, unless

the surgeon is familiar with the particular anatomic characteristics. The distinguishing features of the syphilitic lesion, as compared with the carcinomatous, are the frequency of the disproportion between the extent of the lesion as demonstrated by the roentgen ray and as observed at operation; the flat infiltrate rather than the spherical prominence of tumor; fibrous and edematous thickening of the serosa and adhesions; associated luetic involvement of the liver, spleen and intestines; and one or more superficial, serpiginous ulcers involving a large part of the plateau formed by the infiltrate, their bases being at a higher level than the normal mucous membrane, in contrast with the peptic type of ulcer.—*W. R. Brooksher.*

VITA, GIULIO. Contributo clinico-radiologico alla diverticolite del colon. (Clinical and roentgen contribution to diverticulitis of the colon.) *Radiol. med.*, 1932, *19*, 1363–1370.

Diverticula of the intestine are slight extroflexions which according to most authors are hernias of the mucous membrane through the muscle layer. When they are not inflamed they do not cause any clinical symptoms and are only occasionally diagnosed on roentgen examination of the digestive tract. When they become inflamed they cause symptoms which, however, cannot be differentiated from those of other abdominal conditions and the diagnosis still has to be made by roentgen examination.

A case is described in a woman of forty-five who for about ten years had had gastric disturbances consisting of acidity, eructation and a feeling of weight in the stomach. She had alternate periods of constipation and diarrhea. When she came for examination she was suffering from anorexia and intense tenesmus and was in a poor condition of nutrition from not eating. Physical examination showed a sausage-shaped mass in the right iliac fossa parallel to Poupart's ligament which suggested tumor of the last part of the colon. Roentgen examination showed little excrescences all along this tract of the colon. A diagnosis of slight, non-obliterating divericulitis was made.

Diverticula are best demonstrated by a roentgen enema; low pressure should be used as high pressure may rupture inflamed diverticula, resulting in peritonitis.—*Audrey G. Morgan.*

PONCHER, HENRY G., and MILLES, GEORGE. Cysts and diverticula of intestinal origin. *Am. J. Dis. Child.*, 1933, *45*, 1064–1078.

Cysts and diverticula arising from the gastrointestinal tract constitute a group of congenital malformations which not only present problems in clinical diagnosis but are of pathologic interest on account of their origin. From the standpoint of origin, the authors are divided into two schools, namely, those who consider all enterogenous cysts and diverticula as arising from remains of the vitelline duct, and those who consider the intramesenteric cysts and diverticula, duplications of the esophagus, mediastinal enterogenous cysts and duplications of the colon as having an independent mode of origin.

In the case reported by Poncher and Milles, the anatomic findings included: (1) an intramesenteric diverticulum arising from the ileum and containing in its wall gastric mucosa and a polyp composed of gastric mucosa and terminally constricted to form incompletely separated cysts; (2) a peptic ulcer of the ileum at the upper point of communication with the diverticulum (probably the source of the hemorrhage clinically observed); (3) extrapleural enterogenous cysts of the mediastinum made up of gastric mucosa, the largest part of which had undergone pressure atrophy and perhaps digestive necrosis; (4) pressure atrophy of the bodies of the second to the seventh ribs, inclusive, secondary to the presence of the large mediastinal cyst, and (5) atelectasis of the right lung and anemia of the parenchymatous organs.

The authors give an extensive review of the literature on the subject. In their case the obscure abdominal pain and intestinal bleeding gave a picture that was complicated by the presence of a large mediastinal tumor. In view of the frequent occurrence of mediastinal enterogenous cysts and abdominal enterogenous cysts and diverticula together, as reported in the literature, the combination, while rare, when met with is characteristic.—*R. S. Bromer.*

CRISTOFANETTI, PAOLO. Sintomo di Stierlin in appendicite. (Stierlin's symptom in appendicitis.) *Radiol. med.*, 1932, *19*, 1438–1442.

In appendicitis the symptoms are not limited to the appendix but may extend to other parts of the digestive tract. Stierlin's spasm of the cecum may bring about various changes in the

form of the cecum. Piccinino has recently described a case of appendicitis with intense spasm of the cecum and ascending colon and the author describes a similar one. Physical examination showed a fusiform swelling the size of a small lemon in the right iliac fossa. On roentgen examination this tract had not filled seven hours after administration of the barium paste. The appendix could be seen at the lower part of it with some injection of the first section. Pressure on the appendix and ileocecal tract did not cause pain. A diagnosis was made of ulcer of unknown nature in the cecum or ascending colon. Operation, however, showed appendicitis.—*Audrey G. Morgan.*

Buisson, Paolo. Ancora sull' interpretazione del mancato riempimento dell' appendice. (Further discussion of failure of the appendix to fill.) *Radiol. med.*, April, 1933, *20*, 493–513.

The author believes that if the appendix does not fill and is therefore not demonstrable on the roentgenogram this by itself is the surest sign that there is a lesion of the appendix. This is only true, however, if the examination has been carried out in the right way. The cases that have been cited in support of the opposite view have been those in which the technique was defective. A barium enema should first be given of 800–1000 gm. barium sulphate in 2.5 to 3 liters of water. At least three barium meals should then be given; they should be liquid and contain not less than 250 gm. barium sulphate. The first two should be given in the morning and afternoon of the first day and the third on the morning of the second day. The patient should not take any food until the stomach and the greater part of the small intestine is evacuated. Roentgenoscopic and roentgenographic examinations should be made in various positions and projections. With this technique negative filling is conclusive evidence of pathological appendix.—*Audrey G. Morgan.*

Ferretti, Luigi. Quadri radiologici di lesioni luetiche del grosso intestino. (Roentgen picture of syphilitic lesions of the large intestine.) *Radiol. med.*, 1933, *20*, 280–292.

Two cases of stricture of the rectum are reported, one in a woman of forty-five and the other in a man of fifty-five. Both had a history of syphilis and strongly positive Wassermann reactions. The first patient had been treated quite energetically with mercury; the second was treated for about six months with mercury but then stopped treatment and was never examined again. Both came for examination on account of painful tenesmus and emaciation.

The characteristic features of the roentgen pictures were a marked stenosis of considerable length, 10 cm. in one of the cases; smooth outlines without the raggedness which is seen in carcinoma and tuberculosis; a gradual and not an abrupt transition from the infiltrated part of the intestine to the normal part; great fixation and rigidity of the infiltrated part of the intestine. In some cases the lumen of the intestine is reduced to the size of a lead pencil and in some cases the lesions are multiple.

The therapeutic test may be useful as a supplement to roentgen examination but it does not of course affect a cicatricial stenosis. In such conditions surgery may be necessary.—*Audrey G. Morgan.*

Åkerlund, Åke. Beobachtungen bei Cholecystogrammen in aufrechter Körperstellung: ein neues röntgenologisches Gallensteinsymptom. (Observations of cholecystograms in the upright position: a new roentgen sign of gallstones.) *Acta radiol.*, 1933, *14*, 74–81.

The author recommends taking series of pictures with the patient standing, using a tube diaphragm and "dosed" compression, particularly for demonstrating small stones. Usually the stones are found to have sunk to the fundus of the gallbladder; this is true both of large and small stones, of very opaque stones and those that are less opaque.

Tumor defects do not change their position in the gallbladder in this way nor do stones that are wedged in its upper part. The formation of valves in the bladder wall or the presence of inspissated calcareous bile may prevent the stones from sinking to the bottom. In relatively rare cases medium-sized transparent gallstones remain suspended in the shadow of the gallbladder.

In 5 cases of very small transparent stones the author has seen a new roentgen sign of cholelithiasis in cholecystograms taken in the floating horizontal layer in the middle of the gallbladder shadow. This rosary-like grouping remained constant in spite of changes of position of the patient and in spite of manipulations made in an attempt to move the stones.

This phenomenon is probably explained by the fact that there are bile fractions of different

concentration and different specific gravity in the gallbladder which do not mix. The position of the stones in the gallbladder is determined by their specific gravity as compared with that of the different fractions. The author agrees with Eliasz that this stratification of bile fractions may explain many obscure points in the pathogenesis of gallstones.—*Audrey G. Morgan.*

VOLPE, VITO. Calcolosi intraepatica solitaria rilevata mediante l'indagine radiologica. (Solitary intrahepatic calculus demonstrated by roentgen examination.) *Radiol. med.*, Jan., 1933, *20*, 26–32.

A man aged forty-one came for examination presenting the symptoms of cholelithiasis. There was nothing important in the family or personal history except an attack of typhoid at the age of eighteen. Roentgen examination showed a mulberry-like shadow in the liver region below the shadow of the 12th rib and about 4 cm. from the transverse process of the 1st lumbar vertebra. Cholecystography showed that it was not in the gallbladder. By examination in various projections the other usual sites of calculus were excluded and a diagnosis of intrahepatic calculus was made. Operation showed a solitary stone in the right lobe which had no connection with the large extrahepatic ducts. It was removed by resection of a wedge-shaped piece of parenchyma.

The author discusses the various theories of the origin of these solitary intrahepatic stones and concludes that this one was caused by an old inflammation, probably dating from the attack of typhoid fever.—*Audrey G. Morgan.*

PARINO, ADRIANO. L'epatosplenografia. (Hepatosplenography.) *Radiol. med.*, Feb., 1933, *20*, 201–238.

The author describes 23 cases in which the liver and spleen were demonstrated roentgenologically by the use of colloidal thorium dioxide. They included 9 cases of tumor, 3 of liver lesions of the cirrhotic type, 2 of acute inflammation of the liver, 2 of lymphogranuloma, 3 of myeloid leucemia, 3 of enlarged liver and spleen of doubtful etiology and 1 of infundibulo-hypophyseal syndrome. He briefly describes the roentgen picture in these cases and discusses the value of the method in the differential diagnosis of abdominal tumors, and the demonstration of cysts, abscesses, gummata, infarcts, cirrhosis, metastases, supernumerary spleens, etc. It is also valuable scientifically in studying blood volume, the physiopathology of the reticulo-endothelial system, etc.

He has never seen any clinical signs either in human beings or animals that indicated any immediate damage of the organs or the blood by this method of examination. But some authors have described histological pictures that seem to indicate that there may be late injuries, due either to the mere presence of the thorium as a foreign body or to a slight radioactivity. All histologists are not agreed as to these findings but so long as the time is too short for definite judgment as to the possibility of late injury the author advises carrying out further experiments on animals and only using it in clinical cases in which the outcome would be hopeless without such examination.—*Audrey G. Morgan.*

ARRIGONI, ARTURO, and PORTA, REMO. Ulteriori osservazioni sulla splenoepatografia con ossido di torio—Thorotrast. (Recent observations on splenohepatography with thorium oxide—thorotrast.) *Radiol. med.*, Jan., 1933, *20*, 1–25.

The authors have continued their work on the roentgen demonstration of the spleen and liver by means of intravenous injections of thorotrast. They ordinarily give three injections of 25 c.c. each before breakfast every day or on alternate days. The dosage may vary somewhat in different cases. The thorium becomes fixed to the cells of the reticulo-endothelial system and produces roentgen contrast. The maximum intensity of the shadow is not seen until two to five days after the last injection but once established the contrast persists for days or even years.

Clinically the method has proved valuable in the diagnosis of certain diseases of the liver localized centrally, such as cysts, abscesses, gummata and tumors, which are hard to demonstrate by other clinical or laboratory methods. It has been possible to demonstrate the lymphatic glands and bone marrow experimentally in rabbits also but the doses required for this cannot be given safely to man. The placenta has been demonstrated in mice.

The intravenous injection of thorotrast has no immediate bad effects either in man or animals, nor are there any histological changes in the organs which can be attributed to the use of the contrast medium. However, the drug

is eliminated very slowly, chiefly through the bile and to a less extent through the kidneys. intestines and even the lungs. In the meantime it seems to have a radioactive effect on the organs impregnated with it. In a patient who died eight months after treatment with thorotrast not only were considerable amounts of thorium found in the viscera but there were parenchymatous changes in the liver apparently caused by the radioactivity of the product. There is therefore evidently some danger in the use of the method.—*Audrey G. Morgan.*

GENITOURINARY SYSTEM

Vajano, Domenico. L'indagine radiologica dell'apparato urinario mediante l'urografia d'eliminazione. (Roentgen picture of the urinary apparatus by elimination urography.) *Radiol. med.*, March, 1933, *20*, 308–379.

There has been considerable discussion of the comparative value of ascending pyelography and descending pyelography by the intravenous method, which the author calls elimination urography. He discusses the question on the basis of his experience in 49 cases of intravenous pyelography.

There is an essential difference in the information furnished by ascending and descending pyelography; the former is purely morphological, the latter both morphological and functional. The different factors that enter into the production of the picture in intravenous pyelography are the condition of the parenchyma and the renal filter, the condition of the kidney pelvis, the condition of the ureters and bladder and of the circulation, and the technique. He discusses the technique and the picture in normal and pathological cases, giving the findings in his cases which are illustrated by roentgenograms.

He concludes that intravenous urography simplifies and at the same time enriches the means of diagnosis available in urinary diseases. There are practically no contraindications to the method and it is absolutely harmless and simple. By the use of this method alone it is possible to study many questions of morphology and function which formerly required the use of various complicated methods. It cannot absolutely replace the use of the ascending method but it can be substituted for it advantageously in many cases.

From the purely morphological point of view it is without doubt inferior to ascending pyelography as the picture given by the latter is more distinct and richer in contrast, as the concentration in the urine of the substance used is much higher. However, in intravenous pyelography the pictures are generally distinct enough to give the desired information and sometimes they are sufficient in themselves alone to show the localization and degree of a kidney lesion and whether surgical operation is indicated. Moreover, the pictures obtained by the intravenous method conform more closely to physiological conditions than those obtained by the ascending method. For these reasons the intravenous method is superior in demonstrating some anomalies of the urinary tract, such as ectopy of the kidney, bifurcated or double ureters, deviations, kinks and diverticula of the ureters, etc. Retrograde pyelography is to be preferred, on the other hand, in showing slight changes, such, for example, as slight defects in the filling of the pelves and calyces, or when diffuse meteorism interferes with the interpretation of the intravenous pyelogram.

Because of its absolute harmlessness intravenous pyelography is to be preferred in all cases in which the cystoscope might harm the patient in any way, as in inflammatory conditions of the ureters, bladder or adnexa, in tuberculosis of the bladder or kidney in pregnancy, old age and childhood and in general in patients who are in poor condition. It is, of course, the only possible method in cases in which there is an obstruction in the ureter which prevents the passage of a sound and therefore the introduction of the contrast fluid. Intravenous pyelography in the majority of cases shows the form and size of the kidney and is valuable in diagnosing anomalies and tumors of the upper quadrant of the abdomen, particularly cases in which the kidney parenchyma is destroyed by tumor without any change in the outline of the organ.

A long bibliography of the subject is given. —*Audrey G. Morgan.*

SKELETAL SYSTEM

Cohen, Philip. Tetany in very young infants; with special reference to etiology. *Am. J. Dis. Child.*, Feb., 1933, *45*, 331–342.

At present it is almost the universal belief that infantile tetany is a manifestation of rickets. Whereas in rickets the usual blood picture is that of a low inorganic phosphorus and nor-

mal calcium content, in tetany the reverse is true, the blood phosphorus being normal or increased and the blood calcium low. The deficiency of the calcium has been proved to be the direct cause of the symptoms of tetany. It has been demonstrated that interrupted or imperfect antirachitic treatment induced tetanic symptoms in the rachitic child. In Gerstenberger's studies, the presence of rickets was first proved by roentgenograms of the bones and a low inorganic blood phosphorus. Insufficient ultraviolet therapy caused some healing of the rachitic bones, at which time the blood phosphorus rose, the blood calcium fell, and tetany ensued. Cohen emphasizes the fact, that, in order to evolve tetany from rickets successfully, the dietary or therapeutic change must be abrupt and must bring about some healing of the rickets. In all such cases, as the phosphorus of the blood rose to a high or normal level, the blood calcium fell within the limits of tetany.

Cohen reports 3 cases of tetany in very young infants. In these infants he believes the common suprarachitic pathogenesis of tetany was not present. Shipley, Park et al. have shown that two types of rickets can be produced by different ratios of calcium and phosphorus, one with a low blood phosphorus and the other with a low blood calcium. The first kind of rickets was never, per se, concomitant with active tetany (though it might be the healing stage); the low calcium type was sometimes associated with active tetany. Cohen's cases lead him to believe that the tetany associated with a low calcium rickets is a contemporaneous expression of primary rickets due to a low calcium diet, distinct from the rickets due to a low phosphorus diet from which tetany may eventuate as a sequel. Certain very young infants are predisposed to this form of rickets with tetany, which may result from the sharp nutritive changes of extrauterine life.

Cohen also concludes that tetany in very young immature infants with no clinical or roentgenographic signs of rickets but with evidences of osteoporosis may possibly be a nonrachitic form of tetany. A congenital deficiency in calcium may develop into a type of infantile tetany comparable to that resulting from osteomalacia and celiac disease.—*R. S. Bromer.*

SCHINZ, H. R., and UEHLINGER, E. Das Hypernephrom und seine Knochenmetastasierung. (Hypernephroma and bone metastases from it.) *Acta radiol.*, 1933, *14*, 56–73.

Biologically, hypernephromas occupy a special place among malignant tumors. They can be differentiated from carcinoma of the kidney only by histological examination. They occur in the majority of cases in the 6th decade of life and four times as frequently in men as in women. Among 34 cases of their own the authors observed solitary metastases in 6 and multiple metastases in 14. Often bone metastases are the first and in many cases the only metastases. The lungs are next most frequently involved. Multiple metastases most frequently occur in the bones of the trunk, the femur and the humerus and are often found in the same bone on both sides. Solitary metastases occur most frequently in the humerus, skull and proximal metaphysis of the femur. Very often bone metastases develop years before the primary tumor is discovered. Small primary tumors, particularly if they are extrarenal, seem to show a special tendency to severe general metastasis.

The roentgen picture in bone metastases of hypernephroma shows osteoclastic processes predominantly; there is little evidence of osteoplastic processes. In some cases the roentgenogram shows a typical picture, while in others it is atypical and a roentgen diagnosis cannot be made. In the typical cases there is a central oval defect in the bone with spontaneous fracture of the diaphyses of the long bones, while in the flat bones the soap bubble picture is typical. The picture is atypical if the destruction of the bone is very far advanced, if osteosclerosis predominates and in cases of multiple bone metastases.

Solitary early bone metastases often cause errors in diagnosis. This may be avoided by remembering the characteristic form of metastases of hypernephroma and the fact that they occur chiefly in the 6th decade and in men.

The operative results are better in hypernephroma than in the majority of malignant tumors of internal organs and better than in carcinoma of the kidney. These tumors are quite resistant to irradiation and therefore operation is to be preferred in all operable cases.—*Audrey G. Morgan.*

SUSSMAN, MARCY L. Chronic osteomyelitis of the spine. *Acta radiol.*, 1933, *14*, 43–51.

Four cases of chronic osteomyelitis of the

spine are described and illustrated with roentgenograms. As in osteomyelitis of other bones no roentgen changes are demonstrable at first. It is from two or three months to a year before roentgen changes appear. The first change is usually an abscess of the soft tissues. The first change in the bone itself is generally a localized hypertrophic spondylitis. This is followed by narrowing of the intervertebral space and later by fragmentation and destruction of the body of the vertebra. After the changes begin they usually progress rapidly and the body of the vertebra may collapse within two months after the beginning of visible roentgen changes. Only a process may be affected at first; in the lumbar region generally a transverse process.

Differential diagnosis from tuberculosis may be difficult but it can usually be accomplished by taking a series of roentgenograms during the course of the disease.—*Audrey G. Morgan.*

Baastrup, Chr. I. On the spinous processes of the lumbar vertebrae. and the soft tissues between them and on pathological changes in that region. *Acta radiol.*, 1933, *14*, 52–55.

Much attention has been devoted in recent years to a study of the spinal column but it has been concentrated on the bodies of the vertebrae and little or no attention has been paid to the spinous processes. But the spinous processes of the lumbar vertebrae without doubt are responsible for a great deal of pain in the lumbar region. The lumbar vertebrae form a series of levers, the short arms of which are the spinous processes. If the normal lumbar lordosis is increased they may be driven against each other with considerable force. This impact, together with the smallness of their contact surfaces, may cause osteoarthritic changes at these points and lead to osteosclerosis of the opposed surfaces and the development of osteophytes at the edges of the contact surfaces. Such changes frequently occur in cases in which the lordosis of the lumbar column is increased by congenital luxation of the hip joint, gibbus of the upper part of the lumbar or lower part of the thoracic region, obesity or possibly even pregnancy, as well as by asthma and certain nervous diseases.

Conditions of this kind are illustrated by roentgenograms of the lumbar spine in patients with various diseases.—*Audrey G. Morgan.*

Jimeno-Vidal, F. Traitement des fractures de la colonne vertébrale. (Treatment of fractures of the vertebral column.) *Presse méd.*, 1933, *41*, 752–754.

Only fractures without paralysis are discussed in this article. The fundamental and unchangeable principles applying in the treatment of all fractures are: (1) reduction; (2) complete and uninterrupted immobilization until bony union has taken place; (3) functional after-treatment.

The object of reduction is to restore the injured vertebra to normal contour and to normal relation with other vertebrae while maintaining the normal curves of the spinal column. Local anesthesia is used, injection being made into the site of injury. A simple and effective method of reduction employs two ordinary kitchen tables of different height, a wooden box to increase the height of the higher one as needed, some cushions for the patient's comfort and two straps to hold the lower body. The patient's prone body is extended between the tables with the chin and arms supported on the higher table. After twenty minutes, reduction is complete. The hyperextension not only restores a crushed body to normal shape but also reduces the subluxation of the posterior articulations or fractures of the arch. There is no danger of too much hyperextension by this method as the prevertebral ligament and psoas muscles readily counteract the body weight and prevent overextension.

Immobilization is obtained by a plaster corset applied over breast, abdomen and back while the patient lies hyperextended. Cut outs are provided to allow full motion of the thighs and shoulders. Immobilization must be maintained until consolidation is complete and the vertebral column is capable of sustaining full weight. This requires a minimum of twelve weeks but may be continued sixteen to eighteen weeks in bad fractures with much displacement or deformity.

A carefully planned system of exercises is put into effect as soon as immobilization is begun and must be continued throughout. The musculature is in better condition at the end of immobilization than before and the spine and ligaments actually stronger than previous to the injury. The psychic injury which is present is also benefited by the exercises. It is a grave mistake to prescribe an orthopedic brace or corset after consolidation is complete and the cast is removed. To do this is to make the patient an invalid for life.—*E. W. Hall.*

GAGE, H. C. A possible early sign of Perthes' disease. *Brit. J. Radiol.*, 1933, *6*, 295–296.

A convexity of the upper border of the neck of the involved femur as compared with the practically straight border of the opposite neck was noted on a roentgenogram made three weeks following injury in a case later proved to be Perthes' disease. The same convexity was found on the films of over 30 cases of Perthes' disease, while a study of over 250 films, taken for other than possible bone disease, did not reveal a similar unilateral convexity except in one case which could not be traced. This curved upper border contributes to the well-recognized thickening of the neck in the well-established case and it is just possible that it is the first and earliest sign.—*W. R. Brooksher.*

OSTERBERG, ARNOLD E., and MILLS, RALPH G. The absence of osteoporosis demonstrated chemically in clinical hyperthyroidism. *Am. J. M. Sc.*, Sept., 1932, *184*, 399–407.

The authors mention the work of Aub and his coworkers and others who have noted a disturbance in the calcium and phosphorus metabolism of patients with hyperthyroidism. These findings associated with an osteoporosis noted in hyperthyroid patients led to the generalization that the demineralization of the bones was the rule in toxic thyroid disease. Taking into consideration the difficulties of evaluating the roentgen findings when studying the effect of disturbed calcium metabolism upon bones, the authors undertook a chemical study of bone tissue removed at autopsy.

Their method was to remove a section from a rib and from the superior ramus of the pubis from patients who had died of thyroid disease. Controls were taken from individuals of the same age group who had not suffered from thyroid disease. Determinations were made of the percentage of dry ash in the bones, the percentage of calcium in the ash, the percentage of phosphorus in the ash, and the calcium to phosphorus ratio. A comparative roentgenographic study of the bone tissue was made before the chemical determinations. Bone specimens from 23 patients and from 78 controls were studied.

This investigation failed to demonstrate a sufficient constant difference in the percentage of ash, the percentage of calcium, the percentage of phosphorus, the calcium to phosphorus ratio or in the roentgenographic opacities to warrant the conclusion that hyperthyroidism is accompanied by osteoporosis.—*J. H. Harris.*

CHAPMAN, EARLE M. Osteosclerotic anemia. *Am. J. M. Sc.*, Feb., 1933, *185*, 171–177.

The author reports two examples of the less known type of osteosclerosis in which the pathological picture is a diffuse increase in the connective tissue or trabeculae in the marrow space, leaving the cortex recognizable. This is not a familial disease nor have multiple fractures been reported. This condition is called myelosclerosis in contradistinction to the other type of osteosclerosis, marble bones of Albers-Schönberg. The fibrosis within the marrow canal crowds out the marrow cells and produces a severe anemia with compensatory hemopoiesis in the spleen, liver and lymph nodes.

The first example of this rare condition seen in the Massachusetts General Hospital was in an Italian glass polisher, aged forty-two. The significant symptoms were weakness, loss of weight, and fever. The interesting findings were marked anemia, splenomegaly and the roentgen picture of diffuse increase of bone density with distinguishable cortex. Biopsy study of the bone marrow showed the characteristic fibrosis of the marrow cavity. Calcium and phosphorus metabolism was normal.

The second example was in a stone cutter whose symptoms and findings were similar to the first except for a mild degree of silicosis of the lung. Neither of these patients gave more than a transitory response to any of the therapy instituted.

Cases similar to these have been reported as examples of aleucemic leucemia because of the findings of immature blood cells. The author believes the condition is not a leucemia, the immature blood cells being explained as the hurried response of an insufficient number of bone marrow cells.

The author believes the condition to be a response to injury rather than a disturbance of metabolism. Both of his cases gave a history of exposure to silica, and the possibility of the silica containing cells being carried to the bone marrow is suggested. However, this observation has not been made in other studies of pneumoconiosis.

Treatment was palliative only; blood transfusions gave the best results. Splenectomy, arsenic and radiation therapy are contraindicated.—*J. H. Harris.*

Chizzola, Giuliano. Sull'osteocondrolisi circoscritta. (Circumscribed osteochondrolysis.) *Radiol. med.*, Dec., 1932, *19*, 1371–1381.

The author describes 2 cases of the disease ordinarily called dissecting osteochondritis and illustrates them with roentgenograms. In one of the two cases, which was not operated on and was followed up for five years, there were two foci of dissecting osteochondritis, the first in the median condyle—its classical site—and the second in the lateral condyle, posteriorly, of the right femur; there was a third focus in the median condyle of the left femur. The other patient had a focus in the median condyle of the left femur and was operated on. A year after the operation a second typical focus appeared in the lateral condyle posteriorly. In both cases the joints showed signs of arthritis deformans.

The histological changes in this condition are well known and were verified by the author in one of his cases by examination of an osteocartilaginous fragment; his examination excluded any inflammation. From these findings he thinks it would be better to replace the inaccurate name of dissecting osteochondritis by that of circumscribed osteochondrolysis which is more in accordance with the facts.—*Audrey G. Morgan.*

Grado, Giuseppe. Sulla malattia di Osgood-Schlatter. (Osgood-Schlatter's disease.) *Radiol. med.*, Jan., 1933, *20*, 49–58.

Osgood-Schlatter's disease was first described in 1903. It affects the supplementary centers of ossification from which the anterior process of the tibia develops. It appears generally between the ages of ten and sixteen and may affect one or both knees. The roentgenogram shows the process completely detached from the diaphysis of the tibia. The disease was at first thought to be traumatic in nature; other investigators have thought it inflammatory. The author considers the question of whether there is a detachment of the process or whether, as a result of some defect of development, there has never been fusion of the process with the diaphysis. He concludes in favor of the latter theory.

He describes a case in a boy twelve years of age who came for roentgen examination for a disease of the right knee which proved to be tuberculous arthritis. The roentgenogram also showed the picture of Osgood-Schlatter's disease. He questions whether it was a true Osgood-Schlatter's disease or whether the tuberculosis had produced lesions which simulated that disease. Certainly it was not a case of essential Osgood-Schlatter's disease as it had developed in the course of a tuberculosis of the knee.—*Audrey G. Morgan.*

Glanzer, Joseph. Total unilateral hypertrophy. *Am. J. Dis. Child.*, May, 1933, *45*, 1056–1063.

Reports of total unilateral hypertrophy or hemihypertrophy are comparatively rare in medical literature. Glanzer reports a case because of the rarity of the condition and because of the unusual congenital anatomic anomaly. The patient, a white girl aged three and one-half years, showed enlargement of the right upper and lower extremities which was noticed by the nurse soon after delivery. The enlargement had persisted in about the proportion noticed at birth. Roentgenographic studies showed the difference in width between the two humeri and the femora and tibiae. The osseous hypertrophy was also present in the bones of the right forearm and the hand.

In discussing the etiological factors, Glanzer mentions: (1) Anomalies in the blood vessel supply and in support of this theory the frequent occurrence of nevi and telangiectases is cited. His patient had such lesions. No attempt has been made to explain the root or cause of this vacular anomaly other than to hint at the possibility of heredity. But Glanzer points out that there is no evidence that hemihypertrophy is hereditary. (2) Wieland regards the cause as the stimulation of some of the embryonic somites to overgrowth. (3) The inevitable explanation of the internal secretionists who hold the hypertrophy to be due to a biochemical reaction causing an irregular distribution of fetal tissues that interferes with the normal glandular secretions of the body. (4) The subject of twinning has been given much prominence in an attempt to explain the one-sided enlargement. Glanzer considers interrupted twinning as propounded by Gesell as the most likely etiologic factor.

In Glanzer's case there is a history of twins in the immediate family and of extensive cutaneous abnormalities of vascular origin.—*R. S. Bromer.*

Balestra, Giovanni, and Bistolfi, Stefano. L'indagine radiologica nelle lesioni traumatiche della linea di Lisfranc. (The roentgen

picture of traumatic lesions of Lisfranc's line.) *Radiol. med.*, Feb., 1933, *20*, 151–199.

The authors review the literature of the subject and describe 31 cases of their own which are illustrated with roentgenograms. They are divided into lesions of the internal half, including fractures of the cuneiforms, isolated fractures of the base of the metatarsals and mixed lesions of both the cuneiforms and bases of the metatarsals, lesions of the external half, including solitary lesions of the cuboid, fractures of the bases of the metatarsals and mixed lesions of the cuboid and external metatarsals, and lesions involving the whole of Lisfranc's line. The lesions of these groups present all possible varieties of combinations.

The variety of these lesions is due not only to the different mechanisms of the trauma but also to the varied positions and conditions of equilibrium of the bones of the vault of the foot, not only in carrying out different movements but also in adapting themselves to external conditions, such as different kinds of shoes, the configuration of the ground, preexisting pathological and constitutional conditions, etc. Examination is not complete unless all the bones and all the joints are shown. The two classical projections are not enough and at least Albers-Schönberg's projection in supination should be added, and if special lesions of the cuneiform bones are suspected an oblique projection also. In spite of all precautions some lesions, such as incomplete fracture lines of the cuboid and cuneiform bones may escape detection. In cases of severe luxation diagnosed clinically the roentgen demonstration of detachment of a bone fragment may explain the failure of reduction and show the proper method of treatment. Certain subluxations often escape even a careful examination, for example, median subluxation of the system of the hallux. This causes long persistence of pain and may result secondarily from flattening of the vault of the foot from weakening of the ligaments. The characteristic roentgen evidence of it is a diastasis between the 1st and 2d cuneiform bones and the 1st and 2d metatarsals. Often it can be demonstrated only by a careful comparative examination of the two feet on the same film with the obliquity of the rays necessary to show this lesion which is of great medicolegal importance.

Among the possible late results are ankylosis of the joints and progressive flattening of the vault of the foot. Examination for the latter must be made in lateral projection. Sesamoid and supernumerary bones are often found, which are not of much importance clinically but are interesting from the point of view of phylogenesis. They are generally bilateral and not hard to differentiate from fracture.—*Audrey G. Morgan.*

BLOOD AND LYMPH SYSTEM

Kato, Katsuji, and Brunschwig, Alexander. Acute leukemia following lymphosarcoma. *Arch. Int. Med.*, Jan., 1933, *51*, 77–89.

In recent years, evidence has been presented that lymphosarcoma and acute lymphatic leucemia are different stages of the same condition. In a table, the authors give a summary of 15 cases previously reported and add the reports of 2 of their cases to prove this contention.

Both cases reported were in children with the typical physical and pathological findings of lymphosarcoma. The lymphoid masses subsided rapidly under radiation therapy in moderate dosage. Within four weeks, the patients returned presenting the typical picture of acute lymphatic leucemia.

The authors question the rationale of treatment of lymphosarcoma by roentgen rays. It is certain that the irradiation has an elective effect upon immature nuclei of rapidly multiplying cells and this is shown by the rapid subsidence of the original tumor masses. However, there is definite indication that the irradiation has a deleterious effect upon the hematopoietic system in these cases.

The sequence of events in cases of this kind is: (1) The normal process of lymphatic differentiation is greatly accelerated, producing pathological hyperplasia of these organs. When confined to organs of primary involvement the condition is called lymphosarcoma or lymphoblastoma. (2) When it extends to other organs of the same system it is called metastasis. (2) When the extension reaches the blood stream the condition is called leucemia.—*J. H. Harris.*

Potter, Eugene B., and McRae, Colin C. Gaucher's disease: Report of 2 cases, with a remission in 1 following the administration of liver extract. *Am. J. M. Sc.*, Jan., 1933, *185*, 92–96.

To the reported 100 examples of this rare disease of primary idiopathic hypertrophy of

the spleen, the authors add 2 cases seen at the University Hospital, Ann Arbor, Mich.

The first case was proved by pathological study of the splenic tissue following splenectomy. This case was not seen after being discharged from the hospital.

The second case was in a boy, aged seventeen, who had had 7 operations upon his lower extremities for so-called osteomyelitis. The right femur was again operated upon and the marrow content was found to be a chocolate-colored gelatinous material which gave no bacterial growth. Microscopic study of this material showed the marrow to be largely replaced by xanthomatous foam cells resembling those found in Gaucher's disease. Slides of material obtained by splenic puncture proved the nature of the disease. The patient was given liver extract and there has been a distinct remission in the symptoms for eleven months. No suggestion as to the modus operandi of the liver extract is given by the authors.

At times, the bone involvement is the predominating finding in this disease. Pain, swelling, redness and exquisite tenderness to palpation may be so marked as to lead to a diagnosis of acute osteomyelitis. The roentgen changes consist of (1) thickening of the shafts of the long bones, (2) localized swellings over the bones, and (3) pathological fractures. The reproduction of a roentgenogram showing the first two of these changes is included.—*J. H. Harris.*

McGRAW, ARTHUR B. Juvenile xanthoma multiplex. *Am. J. Cancer*, 1933, *18*, 345–356.

An example of juvenile xanthoma multiplex is added to the previously reported 160 cases. The condition occurring before and during puberty is characterized by multiple scattered cutaneous nodules of typical gross appearance and characteristic microscopical picture. It is associated with good health and occasionally with xanthomatous lesions of other body structures.

The treatment in the author's case and in those reported by others was quite unsatisfactory. There is some tendency to regression as adult life is approached.

The histological study reveals the typical large foam cells seen in xanthoma elsewhere. This foamy reticulated appearance of the cells in the fixed stained sections is due to the dissolving out by the fixing agent of the large shiny yellowish droplets of lipoids in the cytoplasm of the cells.

The author reviews the different theories regarding the etiology of the disturbed lipoid metabolism which is the basis of the rare condition. Some of the more recent investigators hold to the view that the disturbance of lipoid metabolism is not one of quantity but rather a disturbance of the mechanism which maintains the optimum concentration of the various lipoid components. Thus, if the balance is upset there will be a partial precipitation of one or more fractions in order to reëstablish the balance. The precipitated lipoids become foreign bodies and are taken up by the reticuloepithelial cells and these become the foam cells which characterize histological findings.—*J. H. Harris.*

MENKES, BENEDIKT. Röntgendarstellung der Blut- und Lymphgefässe an der Leiche und am Lebenden mittels Umbrathor und Thorotrast. (Roentgenologic demonstration of the blood and lymph vessels in the cadaver and living subject by means of umbrathor and thorotrast.) *Fortschr. s. d. Geb. d. Röntgenstrahlen*, Nov., 1932, *46*, 571–575.

Umbrathor and thorotrast are excellent means for the roentgenologic presentation of the blood and lymph vessels in the cadaver for demonstration and research purposes. Thorotrast is the most suitable substance so far investigated to use in the living subject. It is hoped that the demonstration of the lymph vessels in the living by means of this substance will open up a new field for roentgenologic research.—*E. T. Leddy.*

GENERAL

BARBACCI, GINO. Osservazioni su di un caso di cisticecosi muscolare umana. (A case of human muscle cysticercus.) *Radiol. med.*, Feb., 1933, *20*, 145–151.

A patient, aged sixty, came for examination of the digestive tract on account of weakness, emaciation, anorexia, intense thirst and slight constipation. His skin was normal and nothing could be palpated in the subcutaneous tissue or muscles. There was no pain even on deep palpation of the muscles. The movements of the trunk and limbs were normal. The leucocyte formula showed neutrophils 70 per cent, basophils 0, eosinophils 4 per cent, monocytes 6 per cent, lymphocytes 20 per cent. Examina-

tion of the feces did not show anything suspicious.

Roentgen examination of the thorax and digestive tract did not show anything abnormal but roentgenoscopic examination showed many small fusiform shadows of varying lengths, the longest about 2 cm., throughout the muscles of the neck, trunk and limbs, most numerous in the axillary regions and in the buttocks. These shadows were easily identified as calcified muscle cysticerci. There were even a few in the diaphragm. Many of the shadows were segmented into 2, 4 or 5 fragments. This fragmentation seemed more frequent in the muscles of the limbs and probably indicated that the walls of the cysts had been fractured by muscle contractions.—*Audrey G. Morgan.*

ROENTGEN AND RADIUM THERAPY

Schnyder, Walter F., and Forster, Paul. Über Röntgenbehandlung bei Netzhautvenenthrombosen. (Roentgen treatment of venous thromboses of the retina.) *Acta radiol.*, 1932, *13*, 615–619.

The authors describe 7 cases of thrombosis of the veins of the retina which they treated by roentgen irradiation. In some of the cases the thrombosis was total, in others confined to certain branches of the veins. In every case the hemorrhage was controlled much more quickly than it usually is by other methods and a vision of an average of 0.5 or 0.6 was obtained. In 2 patients, both over eighty years old and with very severe symptoms, there was a recurrence of disturbance of vision and peripheral detachment of the retina, but these were eventually corrected in both cases. The dose in all cases was 3×40 r with a filter of 0.5 mm. zinc and 1 mm. aluminum, with intervals of two or three days between irradiations.—*Audrey G. Morgan.*

Alpers, Bernard J., and Pancoast, Henry K. The effect of irradiation upon normal and neoplastic brain tissue. *Am. J. Cancer*, Jan., 1933, *17*, 7–24.

A study was made on brain tumor tissue removed before and after irradiation was administered and an effort was made to evaluate the effect of this therapy upon different types of brain neoplasms. The effect upon normal brain tissue was also studied. From a group of 63 cases, 22 suitable for study were chosen; 8 were medulloblastomas, 6 were spongioblastoma multiforme, 4 were ependymomas, 2 were oligodendrogliomas and 2 were astrocytomas.

The changes noted following irradiation were: changes in the blood vessels, a patchy death of cells, increase in connective tissues troma and the presence of necrosis. It was found that medulloblastomas were sensitive to irradiation but the necrosis found was patchy and living cells were found throughout the tumor. The stroma and blood vessels of ependymoma were affected but not the tumor cells. Oligodendroglioma, astrocytoma and spongioblastoma multiforme showed no lasting effects. It was somewhat difficult to evaluate the radiation effects in all cases, as in some there was considerable time interval between the irradiation and the post-irradiation examination.

Normal brain tissue showed a fatty degeneration of the cells of the cortex and in the Purkinje cells of the cerebellum. It is significant that there were no blood vessel changes of any consequence noted. The authors conclude that normal brain tissue will withstand irradiation in rather large amounts and they believe that maximum dosages should be employed in treating brain tumors. Necessity of adequate tumor dosage is emphasized and the possibility of obtaining the proper depth dose with radon implants is mentioned.— *J. H. Harris.*

Desjardins, Arthur U. Radiosensitiveness of cells and tissue, and some medical implications. *Arch. Surg.*, Nov., 1932, *25*, 926–942.

Within the past thirty years the effect of irradiation upon the different types of tissue has been determined many times. Cells are classified according to their radiosensitivity in the following order: lymphoid cells; polymorphonuclear and eosinophilic leucocytes; epithelial cells, basal epithelium cells of the salivary glands being most sensitive, and those of the testis and ovaries being the next most sensitive; endothelial cells of the blood vessels, pleura and peritoneum; connective tissue cells; muscle cells; bone tissue and nerve tissue.

The destruction of cells is characterized by disorganization and fragmentation of the nuclear chromatin and by the scattering of the fragments of the chromatin between the remaining intact cells and in the reticular spaces. The fragments of chromatin undergo phagocytosis by adjacent cells, which cells in turn disappear in a few hours. If the amount of irradiation has not been intense enough to destroy

all the cells, complete restoration occurs in from one to three weeks.

It is incorrect to think of irradiation as having a stimulating effect. An acceleration of cellular activity may be noted but this must be regarded as an effort to counteract or compensate for noxious influence of the rays. Continued acceleration of metabolism cannot be produced.

The value of radiotherapy in acute inflammatory conditions as furuncle, carbuncle, lymphadenitis, pneumonia in certain stages, parotitis and erysipelas, is pointed out by the author; the effect being due to the destruction of the invading leucocytes which makes available protective substances more rapidly than would normally be the case.

The specific sensitivity of different kinds of cells is the most important single factor in the treatment of malignant neoplasms. The susceptibility of neoplasms to irradiation agrees closely with the radiosensitivity of normal cells of the same kind as those from which the tumors are derived.—*J. H. Harris.*

Peter, Gustavo. Zur Entwicklung der fortgesetzten Kleindosis. (Development of the method of prolonged small dosage.) *Strahlentherapie*, 1933, *45*, 181–188.

The author discusses the development of the various protracted, fractional and long-continued weak irradiation methods and describes his own method of continued or protracted small dosage. He began the method in 1922 and has modified the technique somewhat. That in use since 1930 is as follows: The individual fraction is increased from 100 to 150 to 200 r_0 measured on the patient with a mecapion, until the optimum for that particular case is found, and it is then repeated daily until a maximum of 3,000–4,000 r_0 per field and tumor is given, depending on the age of the patient and the size of the tumor. The fraction is protracted to 25–45 minutes, using 1.5 ma., 0.5 mm. copper filter and 30–40 cm. focus-skin distance. The total series is protracted for four to six weeks. If the series is to be repeated not over 2,500 r_0 per field is given and an interval of four to eight weeks without treatment is interposed before the next series. The details of 9 cases treated by this method are given.

From a comparison with earlier results he concludes that the use of the maximum total dose is the most important factor in the new method of irradiation. The fractioning and protraction are protective factors used in attaining maximum dosage. In especially sensitive tumors (skin tumors) and where economy must be considered, good results can be obtained with relatively low maximum doses. The lower the total dose, the less necessary fractioning and protraction are.—*Audrey G. Morgan.*

Hammer, G. Röntgenulkus nach Coutardbestrahlung. (Roentgen ulcer after irradiation by Coutard's method.) *Strahlentherapie*, 1933, *46*, 545–549.

All authors who have used Coutard's protracted fractional irradiation are agreed that the skin reactions that occur after it are harmless and heal in a short time. No late injuries have been seen after an experience of eight to ten years. The author has used it in about 100 cases and has never seen an injury before. But he describes the case of a man aged sixty-eight with carcinoma of the rectum who was irradiated with a dose of 2,700 r in 15 treatments of 180 r each. The usual moist radioepidermitis was followed in the course of five or six months by a true necrotic ulcer on one of the sacral fields. The patient was not bedridden so there was no injury from pressure. The ulcer differed in some respects from an ordinary roentgen ulcer. It was painless and had hard, elevated edges. The author concludes that this was a case of abnormal reaction to irradiation by Coutard's method, as it differed not only from the usual moist radioepidermitis after Coutard's method but also from the ordinary roentgen injury from overdosage. The total dosage was not too high in this case. It was relatively low and distributed over a relatively long time. The case shows, however, that Coutard's method of irradiation may cause injury of the skin, though fortunately it rarely does.—*Audrey G. Morgan.*

Hoede, Karl. Erfahrungen über die Röntgenbehandlung der lupösen Hauttuberkulose. (Experience in the roentgen treatment of lupus.) *Strahlentherapie*, 1933, *45*, 217–234.

Frequent failures have been reported after the roentgen treatment of lupus and some authors have considered it dangerous in producing skin cancer. The author reports 31 cases treated in his own clinic in 17 of which perma-

nent cure was brought about by roentgen treatment alone. Among 8 other cases that had been irradiated elsewhere there were 4 permanent cures, making a total of 21 out of 39 cases. Statistics show a cancer incidence after roentgen treatment in only 3.2 per cent of 131 cases. Cancer has been known to develop after other methods of treatment also. His cases show that complete and permanent cure of lupus with roentgen treatment alone is possible. The average dose in his cured cases was 3 to 4 H.E.D. given within six months to a year. The shortest observation time since the last irradiation is nine years. More than 3 H.E.D. should not be given in a year on the same place.

He concludes that while complete cure of lupus is possible with roentgen treatment alone it should not generally be used alone but in connection with other treatment. When it is cautiously and properly used it shortens the time required for Finsen light treatment.—*Audrey G. Morgan.*

RICHARDS, G. E. The treatment of external cancer by radiotherapy. *Canad. M. Ass. J.*, March, 1933, *28*, 246–255.

Second only to the urgent importance of early diagnosis of epithelioma of the skin is the choice of treatment first employed. Previous unsuccessful therapy is a condition which materially complicates the treatment. Excision with postoperative irradiation is still employed, but, according to the radiologist, this is unnecessary and mutilating. Excision of sufficient extent may be impossible, requiring the radiologist to assume entire responsibility for recurrence, when, by the same procedure employed to prevent the recurrence, the lesion could have been cured. Primary lesions at the mucocutaneous junctions differ widely in their response to radium therapy, but are alike in that they are complicated by the danger of early involvement of the regional lymphatics, the factor which frequently determines the ultimate treatment result. Epitheliomatous lesions arising on the vulva or the male external genitalia show a small percentage of cures by irradiation alone. The vast majority of epitheliomas of the lip can be healed by radium with but slight scarring. Involvement of the regional lymph nodes is the real problem for treatment in these instances.—*W. R. Brooksher.*

STEWART-HARRISON, R. Das Lippenkarzinom. (Carcinoma of the lip.) *Strahlentherapie*, 1933, *46*, 401–434.

The literature of the subject is reviewed and the author's own material of 42 cases from the Zurich Clinic from 1919 to 1931 discussed, particularly with reference to the comparative results of irradiation and surgical treatment. These results are compared with other modern statistics particularly from the foreign literature and it is found that irradiation of the primary tumor in carcinoma of the lip gives freedom from symptoms for three years or more in 70–80 per cent of all cases; operative treatment also gives freedom from symptoms for three years in about 60 per cent of the cases. In some statistics this figure is considerably smaller.

The treatment of the regional glands is discussed from the same point of view. The author concludes that a considerable percentage of glands that are barely palpable are not carcinomatous. Some other authors disagree with this conclusion.

He concludes that the treatment of choice for the primary tumor is irradiation. In very small carcinomas of the lip a single maximum roentgen dose of 1,200–1,500 r may be used without previous electrocoagulation. Cross-fire radium therapy may be used even in further advanced tumors, and still severer ones can be treated with radium needles. If the tumor has extended to the lower or upper jaw or the mucous membrane of the mouth, as sometimes happens in carcinoma of the angle of the mouth, radium should not be used, at least not as the only treatment, but both the primary tumor and the regional glands should be given protracted fractional roentgen irradiation. If a residual tumor remains it may be treated by radium, though there is considerable danger of late injury, or electrocoagulation may be used. Cases that are too extensive for cure to be hoped for may be given palliative treatment with simple fractional roentgen irradiation, possibly combined with electrosurgical removal of necrotic masses. The method of choice for the regional glands if they are not suspicious is expectant treatment, keeping the patient under observation. If the glands are suspicious or definitely carcinomatous they should be cleaned out by Crile's method and after-irradiation given.

A table is given showing the author's own results; 55.8 per cent of the patients are living after an observation time of three to thirteen years and are free of symptoms.—*Audrey G. Morgan.*

D'Emidio, Angelo Santoro. La radiumterapie nei reticolo-endoteliomi—reticulomi—delle amigdale a del cavo faringeo. (Radium therapy in reticulo-endotheliomas—reticulomas—of the tonsil and pharynx.) *Radiol med.*, March, 1933, *20*, 273–280.

The author briefly describes the histological appearance of malignant reticulo-endotheliomas whlch are characterized by invasion of reticulo-endothelial tissue. He believes that they are true malignant tumors, though some authors have described them as simple inflammatory hypertrophies.

He gives histories of 3 cases. The first was in a workman, aged forty-nine. He had a tumor of the left tonsil with metastases in the lateral cervical glands. He was irradiated with a gauze apparatus containing 4 foci with 10 mg. radium element under a filter of 2 mm. platinum with a distance of about 3 cm. between the focus and skin, the irradiations being given on the lateral cervical and submaxillary regions of the left side for twenty-one days, producing intense erythema of the skin. This was on May 11, 1931. On June 28 not a trace of tumor could be found. In April, 1932, the irradiation was repeated as a consolidation treatment according to the author's custom. The patient is free of symptoms after a year and a half.

The second case was in a peasant woman aged eighty-two, with a tumor of the lymphatic cord of the right half of the pharynx. It had also invaded the tonsil and the right pillar of the fauces and the right lateral cervical glands. The initial treatment, the same as in the other case except that it was only kept up for seventeen days, was given three months ago. The patient is in excellent health and free of symptoms but a consolidation treatment will be given.

In the third case the tumor was in the vault of the pharynx. Radium treatment on March 16 was as in the other cases except that 5 foci on the left half of the face and the lateral cervical region were used. The tumor decreased in size and the patient requested discharge as he felt well. He was advised to come back for further treatment but refused to do so. He returned August 1 with a large recurrent tumor. He was again treated with 8 foci of 10 mg. radium but showed signs of intracranial involvement and died in fifteen days.

In connection with these cases the author emphasizes the danger of underdosage. Too small doses produce radium resistance which makes treatment more and more difficult. The maximum saturation dose which does not injure the normal tissues should be given. But with the proper technique he thinks these reticulo-endotheliomas are particularly sensitive to irradiation.—*Audrey G. Morgan.*

Palumbo, Vincenzo. A proposito della tecnica Curie-terapica nei tumori dell'ipofisi e dei seni para-nasali. (Technique of radium therapy in tumors of the hypophysis and paranasal sinuses.) *Radiol. med.*, March, 1933, *20*, 303–307.

Radium treatment for tumors of the hypophysis and paranasal sinuses may be given by cross-fire from outside, by tamponing the radium in the pharynx or by opening the sphenoid sinus and inserting the radium in it, thus getting direct action on the tumor.

The author describes a case of tumor of the hypophysis in a woman of sixty-three treated by this latter method. Disturbance of vision began in 1921 and progressed until the patient was almost completely blind. A tumor of the hypophysis was diagnosed and roentgen treatment given in the summer of 1922 without any result. Radium was then tamponed into the pharynx, also with negative results. In the beginning of 1923 another series of roentgen irradiations was given without any effect. In the summer of 1923 the sphenoid sinus was opened by the Hirsch method through the nose and radium applied. This caused a rather violent reaction with high fever and headache. After two months improvement began and has continued progressively until now the patient has sufficient vision for her needs. Her general health is excellent.—*Audrey G. Morgan.*

Severeano, J. Die Radiumtherapie bei den Heoplasmen des Gaumensegels. (Radium therapy of tumors of the soft palate.) *Strahlentherapie*, 1933, *45*, 177–180.

Radium is the only treatment of tumors of the soft palate. There is no method of surgical treatment that would not hasten death.

The author has treated 37 cases since 1920, one of lymphosarcoma, 15 of prickle cell cancer and 21 of basal cell epithelioma. Radium needles were used in 34 of the cases and glass tubes filled with radium in 3 cases in which the tumors were small and back of the midline so that needles could not be implanted. Small needles 1 to 3 cm. long were used containing 0.66 to 1.33 mg. radium. The focal distance was 10–15

mm. and the duration of the irradiation three to five days depending on the size and radiosensitiveness of the tumors. The author believes these small doses not only destroy the cancer nests but stimulate the local defensive forces of the stroma.

Radium necrosis of the hard palate occurred in one case of fibrosarcoma which had infiltrated the periosteum. The patient, a boy aged nine, had been given 1,152 mg-hr. irradiation. This was the only case in which any such accident occurred. Radium dermatitis of the tongue occurred in almost all of the cases but it was so slight as to be of no practical importance as a screen of "Stenz" mixed with barium sulphate modelled to the arch of the palate was used which absorbed the secondary radiation.

Four of the patients have been free of symptoms for more than five years, 8 for more than two years, 16 for more than one year and in 9 cases there were recurrences in the regional lymph glands. The author is convinced that if the patients would come for treatment as soon as an ulcer or tumor of the palate is noted the majority of cases could be completely cured.—*Audrey G. Morgan.*

ROSSELET, A. La Röntgenthérapie de la maladie de Basedow et des hyperthyroidies. (Roentgen therapy of Basedow's disease and hyperthyroidism.) *Acta radiol.*, 1933, *14*, 13–27.

The author discusses the radiobiology of roentgen therapy in Basedow's disease rather than the results of treatment, which have been taken up in many previous publications. Statistics show that excellent results are obtained by roentgen treatment in hyperthyroidism in spite of the fact that the doses used are much too small to bring about the destruction of cells which is necessary for the treatment of tumors. The maximum dose of 1,200 to 1,500 r must be divided into several series of irradiations. Statistics show that the number of failures decrease when the number of series of irradiations are increased and that the improvements obtained are more lasting.

It is probable that the cells of the thyroid are not the original seat of the disturbances of hyperthyroidism but that they are acted on secondarily by changes taking place outside the thyroid in the secretion of the endocrine glands, changes probably induced by the action of the vegetative nervous system. In 1929 Crile obtained results similar to those of partial thyroidectomy by removal of one suprarenal gland, and Zimmern has recently reported rapid improvement resulting from stimulation of the sympathetic and parasympathetic nerves in a case of exophthalmic goiter which had not been improved by irradiation of the thyroid.

It is evident, therefore, that the sensitiveness of the cells to irradiation is by no means the only problem in radiobiology.—*Audrey G. Morgan.*

MAYNEORD, W. V. The plane surface applicator. *Acta radiol.*, 1933, *14*, 95–103.

The author has tried to calculate mathematically the best distribution of a radioactive substance on a superficial apparatus to be used at a short distance in order to get a uniform irradiation on a parallel surface with the same radius. He finds that a satisfactory approximation can be obtained by superimposing circular and disc-shaped sources. He gives curves showing the distribution under the conditions that are apt to occur clinically. Curves are also given showing the relative amounts of radium required on circular applicators of different sizes used at different distances to produce the same intensity of irradiation on the surface.—*Audrey G. Morgan.*

LÜDIN, MAX. Zur Strahlentherapie der Basedow'schenkrankheit. (Roentgen therapy of Basedow's disease.) *Acta radiol.*, 1933, *14*, 28–32.

The author is an ardent partisan of the roentgen therapy of Basedow's disease and says that the only objections made to the treatment are made by surgeons. He even accuses the surgeons of unfairness in the manipulation of statistics to the disadvantage of roentgen therapy.

The arguments urged against roentgen therapy by the surgeon are: (1) the danger of irradiation; (2) the long duration of the treatment; (3) the recurrences; (4) the lack of demonstrable histological changes in irradiated goiters, and (5) the deaths.

With reference to the first point he says that adhesions of the capsule have been observed after irradiation, but they do not interfere with operation if it becomes necessary later. The necroses of the larynx and myxedema that were formerly sometimes seen after intensive

irradiation are no longer seen with the improved technique now in use. The treatment does require a longer time than surgery and the latter is sometimes to be preferred for that reason. He also admits that recurrences are more frequent after irradiation than after surgery. It is true there has been no histological demonstration of anatomical changes in the thyroid after irradiation but that does not affect the value of the cures. Deaths after irradiation in Basedow's disease are often due to the fact that this treatment is given as a last resort in hopeless inoperable cases. The patients die in spite of the treatment, not because of it, and the deaths should not be attributed to it.—*Audrey G. Morgan.*

Zweifel, C. Giebt es Todesfälle im Anschluss an Basedowbestrahlung? (Does irradiation in Basedow's disease cause death?) *Acta radiol.*, 1933, *14*, 33–42.

Recently objections have been made to roentgen therapy of Basedow's disease on the ground that it sometimes causes death. The author therefore reviews the reported cases of death following irradiation of Basedow's disease to determine whether these objections are justifiable.

The literature shows 28 cases in which death is assumed to have been caused by roentgen or radium irradiation. In more than half of these, however, the death may have been due to other causes, such as operation, rapid progress of the disease or a concurrent infection. There are only 11 cases in which the death may be considered caused by the irradiation. This is a very small number in view of the thousands of cases that have been treated by irradiation. Moreover, these were all extremely severe cases in which the patients died within from one to ten days after the last irradiation, even when previous irradiations had been borne without any bad effects. It is hard to explain these deaths. It seems probable they were due to an early endocrine shock reaction.

Basedow patients with acute infectious diseases, such as angina, for instance, should not be treated by radiotherapy.—*Audrey G. Morgan.*

Mojarowa, E. N. Der Kohlehydratstoffwechsel bei Basedowkranken und seine Veränderung unter dem Einflusse der Röntgentherapie. (Carbohydrate metabolism in Basedow patients and changes in it under the influence of roentgen therapy.) *Strahlentherapie*, 1933, *45*, 307–328.

Carbohydrate metabolism is disturbed in all cases of hyperfunction of the thyroid gland. In the majority of cases there is increased metabolism. The cases in which it is decreased are either mild ones with a predominance of the vagus, or very severe ones in which there is probably an insufficiency of the suprarenals. The hyperglycemia in the majority of cases is moderate. It reaches higher degrees in cases of Basedow's disease than in those with mere hyperthyroidism. Carbohydrate tolerance is, as a rule, decreased, more so in Basedow's disease than in mere hyperthyroidism. The character of the alimentary curve is an indicator of which organ is affected in polyglandular disease.

Irradiation of the thyroid and thymus tends to restore carbohydrate metabolism to normal. The changes in the sugar content of the blood for the first twenty-four hours are transitory; the changes which occur as a result of the total treatment are permanent. The changes in carbohydrate metabolism are an objective index of the results obtained. Improvement shows that the method of treatment being used is the correct one. In cases in which there is no improvement in carbohydrate metabolism even after intense roentgen treatment, the method of treatment must be changed, bearing in mind that other organs that help to regulate carbohydrate metabolism may be involved.—*Audrey G. Morgan.*

Tinker, Martin B. Results of surgical treatment of malignant goiter. *Arch. Surg.*, April, 1933, *26*, 705–711.

The author maintains that the commonly accepted bad prognosis of malignancy of the thyroid is not entirely justified by his experience. He bases this contention upon the fact that the most common malignant disease of this gland is adenocarcinoma, which grows slowly, metastasizes late and is radiosensitive. Permanent results are influenced by the same factors that play a part in any malignant disease, i.e., location, extent, duration of the disease, type of malignancy and the skill, experience and methods of the operating surgeon. He believes that the use of radium and roentgen rays in combination with electrosurgery is of greatest importance in obtaining good results.

Tinker discusses the prognostic importance

of the location of the lesion, the malignant cells most distant from the capsule and the lymphatic drainage being less likely to escape beyond the gland. The type of neoplasm is considered, infiltrating scirrhous carcinoma and sarcoma being hopeless, while adenocarcinoma is frequently amenable to treatment.

The value of electrosurgery and gentle manipulation is stressed in the consideration of treatment. The thorough eradication of the growth enhances the possibility of satisfactory results from irradiation.

The results of numerous clinics are given in the discussion of prognosis: these vary from very poor results to the author's report of 8 cases living five years, 6 living six years, 5 living seven years, 2 living eleven years and one alive at the end of thirteen years.—*J. H. Harris.*

Herrnheiser, G. Die Strahlenempfindlichkeit des Bronchialkarzinoms. (Radiosensitiveness of bronchial carcinoma.) *Strahlentherapie*, 1933, *45*, 269–280.

Until recently cancer of the lung has been considered practically refractory to the action of roentgen rays. Lenk says in his recent text that carcinoma of the bronchi and its gland metastases are practically refractory to irradiation and that in the cases in which improvement has been reported the decrease of the shadow was only due to the overcoming of an atelectasis or the absorption of a pneumonic infiltration. The author refutes this argument on the basis of 2 cases which he describes and illustrates with roentgenograms and which he is convinced show actual retrogression of bronchial carcinomata. The question of radiosensitiveness is of course a relative one and depends to a certain extent on the method of treatment. Lung cancers are not very sensitive to irradiation but are by no means completely refractory. The dosage varies in different cases. That used in his first case, about 4,500 r, was high but not maximal. All factors which interfere with the treatment should be recognized and overcome as far as possible. One such factor is the intense leucopenia which appears early in the course of protracted fractional treatment. Possibly it is due to the irradiation of particularly large amounts of blood on account of the proximity of the heart and large vessels.—*Audrey G. Morgan.*

Saupe, E. Pigmentverschiebung an der Brustwarze nach Röntgenbestrahlung. (Shifting of pigment on the nipple after roentgen irradiation.) *Strahlentherapie*, 1933, *46*, 397–398.

A man of fifty-nine came for treatment for a tumor of the hilus on the right side with large metastases in the mediastinum. Dyspnea was so intense that he could not sit up. From June 16 to 27, he was irradiated over two fields each front and back 10×15 cm., 30 cm. focus-skin distance, 176 kv., 0.75 mm. copper filter, one skin erythema dose per field. This brought about only slight improvement in the subjective findings. He came back in worse condition on September 8. The shadow had increased. From September 13 to 21, the same series was repeated. He was discharged in poor condition. On November 5 he came back in surprisingly good condition, with dyspnea only on walking uphill and the shadow of the tumor greatly decreased.

The skin over all the fields of irradiation was moderately pigmented. The right nipple and inner zone of the areola was almost completely depigmented. There was only a narrow ring of peripheral pigmentation. But at the upper inner circumference there was a small triangular zone intensely pigmented exactly at the lower lateral corner of the right anterior field of irradiation. The left nipple was unchanged. It lay outside the field of irradiation. It looked as if the pigment of the right nipple had been drawn into the small triangular area that lay in the field of irradiation.—*Audrey G. Morgan.*

v. Kemeri, D. Die Rolle der gleichzeitigen Leber- und Milzbestrahlung in der Behandlung pyogener Prozesse. (Simultaneous irradiation of the liver and spleen in the treatment of pyogenic processes.) *Strahlentherapie*, 1933, *46*, 355–364.

In addition to vaccines and different methods of local treatment, the author has used roentgen treatment in pyogenic processes, such as furunculosis and phlegmons. Among 34 severe cases 14 (about 41 per cent) were cured by local roentgen treatment alone. In 11 cases (about 33 per cent) freedom from recurrence was attained by repeated vaccine treatment following roentgen treatment. In 9 cases (about 26 per cent) the process recurred even after local roentgen treatment followed by vaccine treatment. In this group he tried irradiation of

the liver and spleen, and all the cases were cured in a short time, although they included 3 diabetics in whom the pyogenic process had persisted for from one to three years. He gives 10 per cent of a skin erythema dose with 0.5 mm. aluminum filter. He has never seen any unpleasant by-effects from the irradiation of the liver and spleen. He therefore recommends the treatment highly in severe pyogenic processes. Any pus foci that are demonstrable should be removed.—*Audrey G. Morgan.*

Beutel, A. Zur Beeinflussung der Leberfunktion durch Röntgenstrahlen. (Effect of roentgen irradiation on liver function.) *Strahlentherapie*, 1933, *45*, 344–348.

The liver of adults has generally been considered relatively insensitive to irradiation. Wetzel reported the first case of injury of the liver by irradiation in 1921. A carcinoma of the stomach was irradiated and autopsy showed necrosis of the left lobe of the liver. Only 40 to 50 per cent of an erythema dose had acted on the liver. In 1924, Case and Warthin reported 3 cases in which autopsy showed injury of the liver after deep irradiation. Almost all the animal experiments in recent years have given negative results.

Some authors, however, report disturbances of liver function by irradiation. Bromeis found increased urobilinuria after irradiation of the stomach in which the liver was not acted on directly. He believed his findings were due to indirect action of toxic substances on the liver. The author tested 20 cases in this way and had positive results in only 7. As his results differed from those of Bromeis he decided to test liver function in another way. After direct irradiation of the liver with doses of 150 to 300 r a galactose test was made and the amount of bilirubin in the blood determined. In 6 out of 12 cases there was a slight but distinctly perceptible increase of bilirubin in the blood. In 4 the amount remained unchanged and in 2 it was lower after the irradiation than before. One case of bladder tumor showed a positive galactose test.

None of the tests described above showed any constant injury of liver function.—*Audrey G. Morgan.*

Dietel, F. G. Die Strahlenbehandlung der Uteruskarzinome an der Universitäts-Frauenklinik Heidelberg. Mit einer Statistik der Jahre 1913–1924. (Radiotherapy of carcinoma of the uterus at the University Gynecological Clinic of Heidelberg, with statistics for the years 1913–1924.) *Strahlentherapie*, 1933, *46*, 201–272.

The University of Heidelberg Gynecological Clinic is one of the institutions that has preferred radiotherapy to surgery for carcinoma of the cervix since 1913, while they have alternated between radiotherapy and surgery for carcinoma of the body of the uterus. They report 438 cases of carcinoma of the cervix with 94 cures, or 21.5 per cent. Among the 177 operable cases there were 69 cures, or 39 per cent cures, and among the 261 inoperable cases 25 cures, or 9.6 per cent. They report 92 cases of carcinoma of the body of the uterus with 28 cures, or 30.4 per cent, and a relative figure of 33.7 per cent for the 83 operable cases. There were no cures among the inoperable cases.

With reference to carcinomata of the cervix, the author concludes that a single irradiation with radium is the treatment of choice. If massive irradiation is to be given up he thinks it better to protract by increasing filtration and decreasing the amount of radium used than by fractionating. The whole cavity of the body of the uterus and cervix should be filled with radioactive substance and radium applied along the vagina also to irradiate the parametrium. A flat apparatus should be applied in front of the portio in every case. The optimum dose on single irradiation and filtration with 1 mm. brass is from 4,800 to 6,000 mg-hr. He has not had sufficient experience with the new filtration of 1 mm. platinum to give exact dosage.

For operable and borderline cases this should be enough. In far advanced cases the parametrium should also be irradiated with roentgen rays. For the roentgen irradiation he has used a method very similar to the Coutard and Pfahler methods, which has given very good primary results. In cases of very large tumors he has been obliged to remove the tumors surgically on account of lack of a sufficient amount of radium. More attention should be given to the general and medical after-treatment of carcinoma patients.

In tumors refractory to irradiation he operates later. The irradiation does not interfere with operation. The important point in these cases is to select the right time for operation.

The article contains a great deal of interest-

ing and valuable detail in regard to the statistical material and the technique, with descriptions and illustrations of apparatus used.—*Audrey G. Morgan.*

HOLTHUSEN, H. Vergleichende Untersuchungen über die Wirkung von Röntgen- und Radiumstrahlen. (Comparative examinations of the action of roentgen and radium rays.) *Strahlentherapie*, 1933, *46*, 273–288.

Experiments are described in which the comparative action of roentgen and radium rays was studied in the production of erythema and epilation and on ascaris eggs.

The author concludes that the experiments do not furnish any evidence that the action of radium rays is essentially different from that of roentgen rays. Even quantitatively the action of the number of electrons formed is proportional in roentgen and radium irradiation. This does not mean that radium can be completely replaced by roentgen rays. The time and space distribution of the rays is not the same. There is also beyond doubt a change in the quality of the action of the rays with changes in intensity. It is possible, and some clinical observations make it seem probable, that continuous irradiation with low intensities which was formerly possible only with radium is the best method of treatment.

The unfavorable space distribution is a distinct disadvantage in radium treatment but the very fact of the rapid decrease of intensity in passing away from the radium makes it possible to concentrate the irradiation in a limited focus in a way impossible with roentgen rays. The smaller the volume irradiated, the larger the tolerated dose. The good effect of radium in carcinomas of the mouth is probably due to the fact that extremely large doses can be given within a very small space. Doses of the size that can be given by intratumoral application of radium cannot be given with roentgen rays.

The author has had no experience with distant radium treatment. His experiments do not indicate that it is superior to roentgen treatment and if it should prove to be so clinically it would indicate that there is some real difference in the nature of radium and roentgen irradiation. The experiments show that little is to be expected from increased tension in roentgen irradiation. The time factor is of very great importance. The most hopeful method for further improvement in irradiation seems to lie in the working out of the best conditions in regard to time.—*Audrey G. Morgan.*

KLUGE, LIESELOTTE, and ZWERG, HANS-GEORG. Ueber die Wirkung der Röntgenbestrahlung auf den Mineralstoffwechsel von multiplen Impfsarkomen der weissen Ratte. (Effect of roentgen irradiation on the mineral metabolism of multiple inoculation sarcomas in white rats.) *Strahlentherapie*, 1933, *46*, 293–310.

Studies were made of the effect of roentgen irradiation on mineral metabolism in multiple inoculation sarcomas in white rats in an effort to determine whether such changes play a part in the destruction of tumors by irradiation.

The experiments showed that in adult female rats weighing 150 to 200 gm. irradiation causes a great increase in the calcium content of the tumor of sometimes as much as 400 per cent. In these animals there is generally at the same time a considerable decrease in the potassium and magnesium content and an increase in the water content. In young female animals, however, and in males there was not any pronounced change. There did not seem to be any constant relation between the signs of degeneration in the tumor and the changes in mineral metabolism. Necrosis of the tumor cells therefore is not caused by any demonstrable shifting of mineral metabolism.

The changes in mineral metabolism are not caused solely by local irritation as roentgen irradiation of other parts of the body may produce the same effect. They are caused by mobilization of hormones, probably chiefly those of the posterior lobe of the hypophysis. In adult female rats there is a certain degree of parallelism between the histological changes demonstrable on roentgen irradiation and the increase of calcium in the tumor.—*Audrey G. Morgan.*

KIESEL, MAGDA. Die Wirkung des Röntgenlichtes auf den Cholesterin Stoffwechsel und ihr Ausgleich durch perorale Lipoidzufuhr. (The effect of roentgen irradiation on cholesterin metabolism and compensation for it by giving lipoid by mouth.) *Strahlentherapie*, 1933, *46*, 311–341.

The cholesterin content of the plasma of rabbits and man was examined before and after irradiation with and without preliminary treatment with cholesterin.

In 11 of 15 rabbits, or 73 per cent, it was found that the cholesterin content of the blood fell after the first irradiation and that signs of roentgen sickness developed. Seven other rabbits were given 5 tablets of colsil in 5 c.c. oil with a stomach sound shortly before irradiation. Four of them showed a considerable increase of cholesterin above the original value two and a half hours after the irradiation. After twenty-four hours there was a considerable increase in the cholesterin content of the blood in all the animals.

The results were similar in human patients. After roentgen irradiation there was a decrease in the cholesterin content in the majority of cases accompanied by roentgen sickness. When colsil was given before the irradiation there was an increase above the original values with no roentgen sickness.

There was no difference in the reaction of the cholesterin content in carcinomatous and non-carcinomatous cases.—*Audrey G. Morgan.*

Holfelder, H. Die planmässige Bestimmung eines optimalen Rhythmus für die Strahlentherapie bei malignen und benignen Erkrankungen. (The systematic determination of an optimum rhythm for radiotherapy in benign and malignant diseases.) *Strahlentherapie*, 1933, *46*, 72–82.

The problem in tumor therapy is to select a rhythm that will destroy the tumor cells and come as near to the limit of tolerance of normal tissue as possible without injuring it. In the plan adopted by the Frankfurt Clinic a beginning dose is selected that has a marked biological effect but does not injure the tissues; this dose is decreased and the intervals lengthened as the treatment progresses.

The average total duration of a series for malignant tumor is two to six weeks and the average total dose at the focus 3–6½ s.e.d. or from 1,600 to 4,000 r, measured in air. The first day a dose of 50–60 per cent s.e.d., or 270–330 r, is given, the second day ¾ of this dose and on the succeeding days only ½ of it, and possibly later even less. For the first two or three weeks the intervals between the treatment are generally twenty-four hours and after that forty-eight hours. Sundays are not counted as treatment days.

The author has compared this with Coutard's method and finds that he has better results with the Frankfurt method. The protracted fractional method gave equally good results only in tumors of the tonsils, the nasopharynx, and lower jaw, the hypopharynx and larynx, while his own method gave very much better results in tumors of the breast, tongue and floor of the mouth, and particularly in tumors of the genitourinary tract and intestines. He found the best total time for a series for the individual kinds of tumors as follows: lymphogranulomatosis 10–15 days, sarcomas of the soft parts 2–3 weeks, bone sarcomas 3–6 weeks, tumors of the pharynx 3–4 weeks, tumors of the breast 10–20 days, carcinomas of the intestine 4–6 weeks, carcinoma metastases 2–4 weeks.

The further the fractionating is carried, the greater the tolerance of the deep tissues as compared with skin tolerance. With this method it may be considered a general rule that the limit of tolerance of the deep tissues is 50–60 per cent higher than that of the skin. When the cross-fire method is used for deep tumors it is advisable to give each individual field a dose of 300–330 r but to irradiate the individual fields in turn so that the same field will not be irradiated over again for several days. Graphs are given showing rhythms for different numbers of fields from 2 to 8.

The author does not claim that his is the best possible method but wishes to emphasize the importance of a systematic study of the biological effect of the different factors in fractional treatment—the total duration and total dose of the series, the number and size of the individual fractions, the length of the intervals and the number of fields to be used in cross-fire treatment and the sequence of the fields. By a careful separate study of these individual factors he thinks schemes can be worked out for the treatment not only of malignant tumors but of various benign diseases, such as tuberculosis of the joints, Basedow's disease, hypertrophy of the prostate, neuralgias, etc. It is very important to see that the size of the fractions and of the total dose are in the proper proportion to the rhythm selected and to the desired therapeutic effect.—*Audrey G. Morgan.*

Schulte, G. Die Röntgentherapie der hypophysären Erkrankungen. (The roentgen therapy of hypophyseal diseases.) *Strahlentherapie*, 1933, *46*, 83–109.

The literature of the subject is reviewed and case histories of 17 of the author's own cases given and illustrated with roentgenograms.

Under the usual conditions for deep therapy the author irradiates 4 or 5 fields—temples, vertex, forehead and occiput with fields 8×12 cm. with a focus-skin distance of 30 cm. In order to avoid loss of hair he does not irradiate one field each day with 80–100 per cent of an erythema dose but irradiates all of the fields each day with 20 or 25 per cent. This takes more time and is less convenient but there are better chances, on account of the frequent focusing, for the rays to strike the hypophysis. With the use of small fields and low tension many fields must be irradiated to reach a dose of 90 per cent S.E.D. at the focus.

Generally a second series of irradiations is given two months after the first. Whether a third series is given depends on the course of the disease. In cases of malignant tumor he has had good results with doses of 2,000–2,500 r applied in four weeks by Coutard's fractional method.

All the cases of acromegaly with disturbances of vision and of the visual fields were greatly improved and most of the patients practically entirely relieved of their symptoms. Considerable improvement was also brought about in a case of dystrophia adiposogenitalis which had persisted for nine years. The effects of treatment were extremely good in 8 cases of chiasm syndrome, among them 2 of malignant tumor. The latter were irradiated by Coutard's method.

The earlier treatment is begun, the better the results. The necessity for early diagnosis cannot be too greatly emphasized. Many practitioners do not recognize the symptoms of tumor of the hypophysis or of brain tumors in general and the patients are treated symptomatically for months.

Both surgery and radiotherapy give good results in tumors of the hypophysis and in this field there should be no competition between surgeon and roentgenologist as to which is the best method but there should be the closest cooperation in order to work out the best method for the individual patient.—*Audrey G. Morgan.*

FELDWEG, P. Ueber die angebliche Aussichtslosigkeit der Strahlenbehandlung beim Drüsenkrebs im Collum uteri. (The reputed hopelessness of radiotherapy of adenomas of the cervix.) *Strahlentherapie*, 1933, *46*, 110–118.

It is a well-known fact that adenomatous carcinomas of the cervix are more resistant to irradiation than pavement cell carcinomas. The prospects for cure in these cases have been considered very poor, though cases of cure have been reported, showing that the outlook is by no means hopeless.

The author reports 27 cases of adenoma of the cervix, 24 treated by radium irradiation and 3 by operation. They show that there is an undoubted relationship between the size of the dose and the course of the disease. With a dose of 300 mg-hr. or less 8 patients survived one year or more, one three years or more and none five years. With a dose of 5,000 mg-hr. 4 patients survived a year, 5 three years and one is well after more than five years. With a dose of 9,000 mg-hr. 2 patients survived more than three years and one is well after more than five years. Both of the patients who were cured were given what was more than the average dose at that time.

Histological examination as well as clinical experience shows that adenomas of the cervix should be treated with as large doses of radiation as possible in as short a time as possible.—*Audrey G. Morgan.*